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Beyond the City

The Rural Contribution to Development

David de Ferranti • Guillermo E. Perry • William Foster
Daniel Lederman • Alberto Valdés

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COVER ART

Danza de Tijeras. 1998. Silkscreen, by Pedro Osores, Huancayo, central Andes, Peru. Courtesy of Frances Wu (Wu ediciones) and the World Bank Institutional Art Program.

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Acronyms and Abbreviations

AKIS	agricultural knowledge and information system
ATPSM	Agricultural Trade Policy Simulation Model
BANSEFI	Banco del Ahorro Nacional y Servicios Financieros (Mexico)
CAFTA	Central American Free Trade Agreement
CAP	Common Agricultural Policy
CBT	Chomitz, Buys, and Thomas
CCT	conditional cash transfer
CDD	community-driven development
CGE	computable general equilibrium
CGIAR	Consultative Group on International Agricultural Research
CGS	competitive grants scheme
CIAT	Centro Internacional de Agricultura Tropical
CIESIN	Center for International Earth Science Network, Columbia University
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
D&PL	Delta and Pineland Seed Company
DC	developing country
DIS	decoupled income support
ECLAC	Economic Commission for Latin America and the Caribbean
EMBRAPA	Empresa Brasileira de Pesquisa Agropecuária (Brazilian Agricultural Research Corporation)
EPZs	export processing zones
EU	European Union
FAIR Act	Federal Agriculture Improvement and Reform Act
FAO	Food and Agriculture Organization
FE	fixed effects
FONDEN	Fund for Natural Disasters (Mexico)
FTAA	Free Trade Area of the Americas
GAEZ	global agro-ecological zoning
GAO	Government Accountability Office
GE	general equilibrium
GMOs	genetically modified organisms
GPW 3	CIESIN/CIAT's Gridded Population of the World dataset, version 3
GRUMP	Gridded Population of the World
GTAP	Global Trade and Analysis Project
HDI	Human Development Index
HT	herbicide tolerant
IARC	International Agricultural Research Center
IDB	Inter-American Development Bank
IFC	International Finance Corporation
IFPRI	International Food Policy Research Institute
IICA	Inter-American Institute for Cooperation in Agriculture
IIASA	International Institute for Applied Systems Analysis
INIA	National Agricultural Research Institution
IRRI	International Rice Research Institute
Km	kilometer
LAC	Latin America and the Caribbean
LCR	Latin America and the Caribbean Regional Vice Presidency (World Bank)
LDC	least developed country
LIC	low income country
LIFDC	low income food dependent country
LMIC	lower middle income country

MERCOSUR	Southern Cone Common Market
MFI	microfinance institution
MFN	most favored nation
MtC	million tons of carbon-equivalent
NAFTA	North American Free Trade Agreement
NAIM/EX	net agricultural importing, net agricultural exporting
NAIS	national agricultural innovation system
NARS	National Agricultural Research Systems
NFEX	net food exporting
NFIM	net food importing
NPC	nominal protection coefficient
NPC_s	net present value of costs
NRM	natural resource management
OECD	Organisation for Economic Co-operation and Development
PANACA	National Park of Agricultural Culture (Colombia)
PES	payments to environmental services
PRAF	Family Allowance Program (Honduras)
PSE	producer subsidy equivalent
R&D	research and development
RDPs	regional development policies
RNFE	rural nonfarm employment
RNFI	rural nonfarm income
RNR	rural natural resources
ROA	Roles of Agriculture project
RR	Roundup Ready
SAM	social accounting matrices
SDI	subsidy dependence index
SIMA	Statistical Information Management & Analysis database
TFP	total farm production
TFPy	total-factor productivity
UMIC	upper middle income country
USDA	United States Department of Agriculture
WDI	*World Development Indicators*
WTO	World Trade Organization
ZEs	Extreme zones (*Zonas Extremas* in Spanish)

Note: All dollar amounts are U.S. dollars unless otherwise indicated.

CHAPTER 1

The Rural Economy's Contribution to Development: Summary of Findings and Policy Implications

THE DEVELOPMENT OF RURAL ECONOMIC ACTIVITIES AND COMMUNITIES IS PIVOTAL TO national well-being. In Latin American and Caribbean history, rural societies have been at the center of both the origins of prosperity and of social upheaval. Rural communities have access to a wealth of natural resources, including arable land and forests, yet they face the highest poverty rates in their countries. Characterized by low population densities and located far from the major urban centers, rural communities must overcome severe restrictions in access to public services and private markets, even in some countries where public expenditures per inhabitant are higher in rural than in urban communities.

While the trade tax structure of the import-substitution industrialization epoch historically discriminated against the stereotypical rural economic activities related to agriculture, farmers nowadays enjoy higher trade protection than the average for manufacturing activities, along with significant government subsidies to specific producer groups in most Latin American and Caribbean economies. But the rural development challenge has again emerged in relation to concerns regarding agriculture's place in international trade negotiations. Specifically, there are questions of both extended market access for the most competitive agricultural subsectors in national economies and of longer transition periods towards liberalization and support for less competitive or "sensitive" subsectors. Also, many countries are reconsidering their—at least at this date—ineffective policies to support the development of laggard regions, which have not benefited significantly either in the protectionist periods or in the recent period of trade opening.

Indeed, most Latin American and Caribbean countries are preoccupied about the state of their rural economy, particularly the competitiveness of rural economic activities, poverty, and environmental degradation. While the majority of Latin American and Caribbean countries have in place trade policies, sector-specific government support policies, social intervention policies, infrastructure development strategies, and various regulatory regimes designed to respond to demands of various subsectors in the rural economy, most of these have focused on problems affecting the rural economy per se, without paying enough attention to how the rural economies (and policies) contribute to overall national welfare. This report aims to fill this gap by systematically evaluating the contribution of rural development and policies to growth, poverty alleviation, and environmental degradation both in rural areas and in the rest of the economy. Specifically, it uses this broad framework to shed light on five critical policy issues for Latin American and Caribbean economic authorities (see box 1.1). For the convenience of readers interested in policy issues, this chapter presents first a summary of the policy implications of our findings. We then turn to the findings themselves, summarizing our methodological approach and main results (see box 1.2).

BOX 1.1

Five critical policy questions for Latin American and Caribbean economic authorities

1. Is there, and should there be, a pro-urban or pro-rural bias in public policies?
2. How do we overcome the underprovision of public goods in the rural sector?
3. How do we optimize the potential effects of trade policies on the rural contribution to development?
4. How do we make rural development more pro-poor?
5. How do we engage in successful territorial development policies?

1.1 Policy implications

1. Is there, and should there be, a pro-urban or pro-rural bias in public policies?

To answer this question we begin by assessing the rural sector's real size and its contribution to national welfare. Using either a sectoral (agricultural activities[1]) or territorial (population density and distance to a major urban center) definition of "what is rural," we find that Latin American and Caribbean rural sectors are much larger than official statistics say, though there are considerable differences by country (see chapter 2). In particular, using the standard Organisation for Economic Co-operation and Development (OECD) definition of rurality (population densities of less than 150 inhabitants per square kilometer and distance to major urban areas[2] of more than one hour travel time) on average, Latin American and Caribbean rural sectors appear to be about twice their official size. Hence, policy makers should probably pay much more attention to rural development policies than they normally do.

More important, our estimates suggest that the expansion of Latin American and Caribbean agricultural activities has a significant positive impact on non-agricultural sector income. Indeed, on average, its effect on national growth and national welfare[3] appears to be almost twice as large as agriculture's share of national GDP, though again there is considerable variation across countries. This result is probably due to the forward linkages and high contribution to net exports of agricultural activities. The effect of expanded agricultural activities on the rest of the economy is larger in those countries where agriculture is a major net exporter and is more integrated with the rest of the economy, as is notably the case in Chile. In contrast to these results, we do not find evidence of significant impacts on Latin American and Caribbean agricultural activities of growth in non-agricultural sectors (see chapter 3). Hence, the continuous reduction of agriculture's relative size as a percentage of GDP should be seen at least partly as a natural consequence of the positive spillovers of its growth on the rest of the economy.[4]

- **These results suggest then that, if anything, there should be a pro-rural bias in public policies in Latin America and the Caribbean.**

So now we turn to the other part of the question. Is there a pro-rural bias in practice in public policies? First, the report finds that the public expenditure allocations to the farm sector[5] are lower than the contribution to overall growth and national welfare that would be derived from an expansion of agriculture in most Latin American and Caribbean countries. Hence, there is an "apparent" pro-urban bias in overall public expenditures. This conclusion, however, would lead one to recommend shifting public expenditures in favor of the rural sector only if rural public expenditures were, at the margin, at least as efficient in promoting rural growth as urban public expenditures are in stimulating urban growth. We doubt this is the case at present, because we find that the composition of rural public expenditures is highly inefficient in most countries, as they are severely biased in favor of subsidies to specific producer groups—such subsidies are usually regressive and inefficient—and biased against the provision of "public goods" (using a broad definition of public goods that includes rural education, health and social protection, rural infrastructure, research and development, environmental protection, and targeted antipoverty expenditures). (See chapter 5.)

Indeed, we find that agricultural incomes would increase much more due to a change in the composition of rural sector public expenditures (from private subsidies to public goods) than due to an increase in rural public expenditures, without changing their present inefficient structure. The

conclusion is that there is an urban bias in the provision of public goods, but that there is at the same time a bias in rural public expenditures in favor of private subsidies. This issue is further discussed below, under question 2.

- **These results suggest that it is crucial to shift rural public expenditures from present large subsidies to specific groups of producers and towards increased provision of public goods (rural education, health and social protection, rural infrastructure, research and extension, environmental protection, and targeted antipoverty expenditures). Once this is done, overall rural sector allocations for the provision of public goods should be further increased at the expense of much more generous urban public expenditures.**

With respect to another policy dimension, when Latin America was pursuing an import substitution strategy in favor of industrialization, there was a severe bias in the trade regime against rural activities. The report finds that such a bias has diminished significantly in most Latin American and Caribbean countries as a consequence of trade liberalization in recent decades, particularly with respect to manufactured goods. If anything, in terms of most favored nation (MFN) border protection, today agricultural activities receive trade protection as high as or higher than the more protected manufacturing sectors in most Latin American and Caribbean countries. Further, the report finds evidence of high inefficiencies arising from the distorted protection pattern to agricultural products and their processing.

- **Hence, the Latin American and Caribbean trade policy issue today is no longer removing a policy bias against the rural sector, but removing the inefficiencies created by some countries' highly distortionary protection favoring some agricultural activities. This issue is further discussed below, under question 3.**

2. How do we overcome the underprovision of public goods in the rural sector?

This report and previous evidence[6] find that further trade opening and provision of public goods to the rural sector can enhance the productivity of agricultural activities and agricultural incomes (see chapter 5). In particular, we present evidence of the very high social rates of return to agricultural research and extension investments. As mentioned, the report also finds evidence that agricultural incomes can be greatly enhanced by changing the composition of rural public expenditures in favor of public goods and away from subsidies to specific producers.

In sharp contrast with this result, there is an underprovision of public goods to the rural sector. The report amply illustrates this, both by the much higher share of expenditures per person in the urban sector in crucial public services—despite the fact that provision costs are higher in the rural sector—and by very large differences in outcomes in favor of urban populations (for example, in educational attainment, access to safe water, electricity, and so on). Why does this happen when, at the same time, many public rural sector expenditures are inefficient due to regressive subsidies to specific producer groups?

We hypothesize that three factors may explain this suboptimal outcome: (1) the stronger political voice of urban consumers and producers of public goods; (2) the political overrepresentation of concentrated landed interests; and (3) the government's institutional structure. Urban consumers of public goods are more vocal politically. The "swing" vote is much larger in cities, reflecting a higher degree of political awareness and development, and urban residents can mobilize, strike, and exert political influence over executive and legislative bodies with much more ease. Unions tend to accentuate this bias of the political process as teachers, health workers, and so on, prefer to be assigned to urban environments and can be more easily mobilized in cities. It is no surprise then that in practice, education and health ministers rarely have rural education and rural health as a higher priority than urban education and urban health. Likewise, infrastructure ministers tend to be more concerned about adequate transport links among cities and between cities and ports, than about rural roads, and tend to pay more attention to water and energy distribution and communications in large cities than in rural areas. Decentralization in service provision has probably mitigated these biases somewhat, but not fully, because these political economy configurations are to some extent reproduced at the regional and municipal levels.

In contrast, ministers and secretaries of agriculture—who are supposed to be the "rural" sector's caretakers in national and subnational governments—have no say whatsoever in the provision of most public goods, with the exception of research and development (R&D), and are subject to enormous pressures from overrepresented, concentrated landed interests (in both legislatures and in their dealings with the government). It is no wonder that governments end up allocating most of their effort and resources to subsidize such

groups through distortionary trade policies (see below) and public subsidies of various kinds—including subsidized credit and frequent bailouts of favored subsectors.

- It is not obvious how to overcome the political and institutional incentives that lead to such an inefficient outcome in public policies toward rural sectors. Sustainable solutions will probably require fostering higher political development and awareness among rural inhabitants and undertaking government reforms that facilitate a higher influence of broad rural interests in the decisions pertaining to the provision of public goods.

3. How do we optimize the potential effects of trade policies on the rural contribution to development?

The report illustrates the well-known fact that most Latin American and Caribbean countries are net exporters of agricultural goods.[7] This "revealed" comparative advantage accords with the fact that these countries are rich in natural resources when compared to other regions. However, there is evidence that land with agricultural potential is not always used to its full potential in many Latin American and Caribbean countries. To some extent, this is due to the underprovision of public goods, as discussed above, and factor market imperfections (in land and credit markets, for example). But it is also a consequence of distortions in international and national trade policies. This report synthesizes the conclusions of previous studies that have provided ample evidence of the substantial welfare gains that could be achieved (especially in developing regions such as Latin America that have rich natural endowments) if significant liberalization of agriculture were eventually to take place both in OECD and developing countries (see chapter 6).

At the same time, the report shows that the potential benefits of increased market access (reduced border protection) are more important for most Latin American countries than those associated with reducing domestic subsidies to OECD producers. Import demand elasticity is much larger with respect to border protection than it is with respect to domestic subsidies. Moreover, as the report discusses, while most Latin American and Caribbean countries are net agricultural product exporters, many are net food product importers (see chapter 2). Net food importers actually benefit from such rich country subsidies. If these subsidies were reduced, world prices would increase and could result in a welfare loss to consumers. However, net importers could reduce their own high tariffs on such products and so neutralize the negative impact on consumers. On the other hand, other countries in the region, especially in the Southern Cone, that are net exporters of products that are highly subsidized in OECD countries, would clearly benefit in a significant way from their reduction.

The report also shows that for some agricultural products, MFN tariff protection is today as high and as distortionary in most Latin American and Caribbean countries as for the more protected manufactured sectors, such as textiles and apparel (with a high frequency of tariff peaks and tariff escalation) (see chapter 6). The region does indeed indulge to some degree in the same protectionism for which it rightly admonishes OECD countries. The consequences of this protection are costly for both groups of countries.

Based on previous and new evidence, the report shows that higher trade openness is indeed associated with higher Latin American and Caribbean agricultural incomes and with lower territorial concentration of economic activities. Indeed, the distance to major cities has become less important as a determinant of wages and employment after trade liberalization in countries such as Brazil and Mexico. In other words, high and distortionary Latin American and Caribbean trade protection is probably harming its rural and national development, as much as the high OECD trade protection. Thus, Latin American and Caribbean countries should also proceed with further trade liberalization of their own agricultural sectors.

Agricultural trade liberalization would benefit consumers and some producers, but at the same time it would hurt those producers that benefit today from high trade protection. Indeed, in most Latin American and Caribbean countries we find today a duality of highly competitive, dynamic, and modern subsectors (including both large and small producers), side by side with subsectors dominated by traditional producers (both small and large) that have not modernized and remain uncompetitive and stagnant, but survive thanks to high trade protection and government subsidies.

As changing land use and deploying resources to more productive activities cannot be done overnight, uncompetitive producers would need time to either increase productivity or shift to more competitive activities. Therefore, it is understandable that political pressures will favor a gradual trade liberalization process for "sensitive" sectors. Given some adjustment time, medium and large commercial producers can successfully restructure.[8] This is proba-

bly not the case for small peasant farmers. Small producers in sensitive sectors would likely require transitional income support and technical assistance. Pure income support would not be enough, as the experience of Mexico with Procampo indicates.[9] Experience with other cash transfer programs (such as Oportunidades) suggest that they are more effective when they are better targeted and conditioned upon specific household investments[10] (see chapter 8).

- **Thus, in conclusion, while Latin American and Caribbean countries should continue to push for liberalization of OECD agricultural markets, they should also liberalize their own agricultural sectors. In doing so, liberalization of "sensitive" noncompetitive sectors should be gradual, and small farmers in these sectors should receive technical assistance and conditional income support to be able to restructure their activities.**

4. How do we make rural development more pro-poor?

The report finds that, *on average,* the expansion of Latin American and Caribbean agricultural activities contributes less to overall poverty reduction (directly and indirectly) than the expansion of non-agricultural sectors. This is to a large extent a consequence of the agricultural sector's smaller size; relative to its size, agricultural growth tends to be slightly more pro-poor on average in Latin America and the Caribbean than overall growth in non-agricultural sectors. Nevertheless, there is considerable variation by country. In some countries, such as Chile, there is a very high elasticity of agricultural growth to national poverty, both due to the labor intensity of postharvest activities and the large indirect effects of agricultural growth on other sectors (see chapter 3). In other countries, such as Brazil, agricultural expansion appears to have less of a poverty alleviation impact, probably due to high land and capital intensity in production, coupled with high land concentration and relatively low forward linkages.

Country case studies based on household surveys conducted for this report indicate that moving out of poverty often requires access to more than one asset (for example, access to land is not enough[11]). Thus "integrated" greater access to assets such as land, infrastructure, and human capital (as well as to technical assistance and credit) would be critical to allow agricultural growth (and the growth in nonfarm rural activities) to be more pro-poor.

These studies also show that households diversify and increase their incomes through access to a variety of rural nonfarm activities (generally paying higher wages than agriculture) and through remittances that are derived from family members' migration (see chapter 2). Hence, public policies should aim at removing labor mobility impediments. In particular, we find that provision of public goods, such as education and rural roads, facilitates both mobility across sectors and migration. These are thus critical components of successful poverty reduction strategies because they will result in both higher agricultural growth and more mobility towards higher paying jobs and activities. In contrast, subsidies to specific activities in specific locations tend to tie employment to unpromising activities, offering little in terms of sustainable income growth and doing more harm than good in the long term.

Our examination of the effect of rural public expenditures reinforces the results from our country case studies. Indeed, we find that shifting the composition of rural public expenditures in favor of the provision of public goods would not only increase overall agricultural incomes, but would increase the average income in the four lower income deciles (see chapter 5).

For the rural poor, conditional cash transfers systems and safety nets are critical complementary programs to help them build their human capital and cope with catastrophic shocks (see chapter 8). The successful experience of programs such as Oportunidades in rural Mexico and of rural pensions in Brazil shows that targeted safety nets can be effective and their poverty reduction outcomes extremely positive. As discussed below, efficient territorial policies to stimulate growth in laggard regions are also complementary tools to make rural development more pro-poor.

- **In summary, policies to make agricultural growth more pro-poor include greater access to "bundles" of assets (human capital, infrastructure, land, and credit), facilitating labor mobility across sectors and localities, targeted income support through conditional transfers, and efficient policies for laggard regions.**

5. How do we engage in successful territorial development policies?

The report shows that differences in regional characteristics (in natural resource endowments, public infrastructure,

quality of institutions, and average education levels) lead to significant regional employment and wage level differences within countries. At the same time, evidence from household surveys indicates that the effect of natural endowments and other assets on household incomes varies significantly by region. And, as indicated above, moving out of poverty requires access to a bundle of assets that also varies by region. Finally, the report illustrates that there is a continuum between purely urban (cities larger than 100,000 inhabitants), semi-urban, rural, and remote areas, and there are close and complex economic ties between large cities, small urban centers, and the rural space in a given territory. All this evidence suggests that territorial (regional) development policies hold significant promise (see chapter 4).

Latin American countries have experimented with a wide variety of regional development strategies (see chapter 9). Unfortunately, few of these policies have been properly monitored or evaluated. Thus, there are not robust lessons about what works and what does not work. Nevertheless, casual evidence suggests that laggard regions are not catching up, even in countries that have devoted considerable efforts and resources to these regional development policies. On the contrary, more often than not, wide regional disparities have continued or are increasing.

- However, some general lessons are emerging from this experience:
  1. **Sectoral and territorial policies need to be integrated.** The household survey data analysis suggests that sectoral policies may have effects that differ substantially in intensity according to regional characteristics. Further, casual experience indicates that potential expansion of specific activities is usually concentrated in a few regions. Thus, sectoral policies without a territorial dimension will tend to be less effective. This may be particularly true in countries where there are significant market failures (for example, in land and credit markets) and suboptimal allocation of public goods across regions, as Alain de Janvry has suggested.[12] Conversely, different regions have their own relative comparative advantages, so that territorial policies would be more effective if they are tailored to specific sectoral requirements.
  2. Given that opportunities, restrictions, and the bundle of efficient policy packages are region-specific (and on occasion, specific to a particular locality), there is a major potential role for regional and local community organizations and subnational governments. **Such institutions have better knowledge of local conditions and would have a role in identifying specific opportunities and constraints and in channeling and coordinating demands for the provision of specific public goods.** This coordination is essential to exploit the potential complementarities of various public goods to have a significant effect on growth and poverty reduction. The experience of community-driven development (CDD) in northeast Brazil and in other Latin American and Caribbean regions appears to support this conceptual conclusion.

Within the general Latin American and Caribbean decentralization trend, subnational governments (in partnership with community organizations) are not only well placed to coordinate demands on the delivery of public goods by central governments, but are also increasingly responsible for the provision of critical public services. Indeed, many Latin American and Caribbean countries have already decentralized the provision of basic education and health services, water supply and sewerage, the maintenance and, in some cases, the construction of public roads, rural electrification, and so on. There are even encouraging experiments with partial decentralization of research and extension services. Obviously, there are significant differences in the roles and importance of subnational governments across federal and unitary regimes and across large and small countries.

Further, as decentralization has progressed, subnational governments are not limiting themselves to the role of public goods and service providers, but in many countries are attempting to become economic development leaders or catalysts in their jurisdiction. These new roles open many opportunities, but also present some challenges. On the one hand, as mentioned above, subnational governments are in a much better position than federal and central governments to identify specific regional or local level opportunities, restrictions, and policy priorities, to provide some of the required public goods and services, and to coordinate their provision with the action of a host of (often disjointed) federal and central agencies in their jurisdiction. They are also better placed to engage regional and local community organizations for these purposes. But, at the same

time, regional and local specific interests can often capture them, and they end up distributing rents among powerful regional and local groups. Further, they may engage in immiserizing competition (for example, in "regional" tax or subsidy wars to attract specific investments) and may fail to identify and achieve opportunities for economies of scale, network interconnectivity, and inter-regional spillovers.

3. The latter suggests that **federal and central governments have a major role to play in the design, regulation, and coordination of territorial development policies.** National laws and regulations should limit the scope for immiserizing competition among subnational governments, should guarantee the compatibility of their aggregate public finance management with overall macroeconomic stability,[13] and permit and encourage achieving economies of scale and positive spillovers in public goods and services delivery. Economies of scale and network interconnectivity are of major importance in many infrastructure areas, but also in social service provision. Spillovers are particularly important with respect to human capital, social protection, and antipoverty programs, as labor mobility implies that investments by one region or locality in these areas may end up benefiting others and thus, left to their own, subnational governments would severely under provide such services. Also, it is essential to guarantee mobility among schools and "portability" of social benefits. That is why national governments normally keep a constitutional mandate to guarantee and finance access to basic education, health, and social protection in almost every country, though the service delivery may be highly decentralized. But this is also true of many infrastructure investments that may end up facilitating migration (and improving national welfare), without having a major effect on the jurisdiction's economic growth.
4. Finally, it is essential to give adequate consideration to all kinds of economic assets in designing territorial development policies. This may be especially important for laggard and remote regions. Indeed, some of the poorest regions may be too remote or have land that is not appropriate for competitive agricultural (or forestry) production, even if public goods were not underprovided and distortionary trade policies were removed. Some of their inhabitants will migrate in search of better opportunities, as they get access to better education, communication, and transport facilities. But these regions may have assets that could produce valuable services (environmental and recreational) to present and future members of society as a whole (and not just for country nationals). However, market failures impede the rest of society from paying inhabitants of these regions (and countries) the true value of these services.

   There are some emerging markets for such services (such as eco-tourism, rural tourism, and carbon certificates), and governments and international organizations should do as much as they can to develop them further. But we are still a long way from where we should be. **As such markets are developed, we should also explore ways to directly subsidize these activities from federal and central budgets and international aid.** "Performance contracts" with remote or poor regions' subnational governments and communities may be the way to go to create the right incentives for them to promote and engage in these valuable activities, instead of incurring high and irreversible environmental costs to achieve short-term low incomes from uncompetitive agricultural activities or, in the worst case, from illicit crops. Problems associated with the latter are usually concentrated in poor and/or remote areas where the state presence and rule of law are weaker; they should be treated in an integral way in a nationally-coordinated approach to regional development, as outlined in this report.

The remainder of this chapter presents the methodological approach and main findings of the report that support these policy conclusions (see box 1.2).

1.2 Summary of findings

1. "Rural" is larger than shown in official statistics

To assess the contribution of rural activities to national development, we must first ask, "What is the rural sector?" Unsurprisingly, our answer is that it depends on the criteria used to define "rural" economic activities and/or populations. However, the evidence in chapter 2 indicates that the Latin American and Caribbean rural sector is actually substantially larger than what official statistics show (see box 1.2).

BOX 1.2

Main findings

1. **"Rural" is larger than what official statistics say.**
2. **The contribution of agriculture and related activities to national Latin American and Caribbean development is about twice its GDP share.**
3. **Regional or territorial policies hold promise to enhance national development, but those applied so far have not reduced Latin American and Caribbean regional disparities.**
4. **Biases in Latin American and Caribbean public policies thwart rural development.**

In practice, there are two broad criteria to identify how we define "rural." The traditional approach equates rural workers and territories with agricultural economic activities. By 2000, the Latin American and Caribbean region's agricultural production, including fisheries and forestry as well as the traditional production of agricultural commodities (referred to as the "rural-natural-resource" [RNR] sector in chapters 2–4), reached about 12 percent of national GDP, on average. When we include the food processing industries as part of agricultural production, the region's average agricultural GDP share rises to over 21 percent. Further, a recent Inter-American Institute for Cooperation in Agriculture (IICA) study (2004) shows that over 50 percent of primary agricultural production is used as production inputs by other industries in nine Latin American and Caribbean countries.[14] Thus it would appear that the expanded definition of primary agricultural production implies that the sector is significantly larger than its GDP share, according to the IICA data.[15] The IICA data also show that such linkages tend to be larger in Canada and the United States, where over 70 percent of primary agricultural production indirectly reaches domestic and foreign consumers via other industries.

GDP numbers may not be good indicators of the relative size of *primary* agriculture (including forestry and fisheries) because food industries and other users of agricultural inputs often use imported rather than domestic agricultural commodities, as well as non-agricultural inputs. A more precise estimate undertaken for this report attributes to primary agriculture only a portion of the value added of other activities that use domestic agricultural products, using their relative weight in total intermediate input use (see chapter 2). This approach demonstrates that forward linkages of agriculture to other industries in Chile, Colombia, and Mexico are indeed important (although lower than the IICA estimates for some countries). This is especially so in Chile, where modernized agriculture has become more integrated with the rest of the economy (see table 1.1). When estimated in a similar manner, backward linkages are much less important in Latin American countries.

The traditional sectoral approach to defining rurality based on primary agricultural production does yield small estimates of the rural sector size. However, when we look at the size of agricultural plus forestry and fishery exports as a share of total Latin American and Caribbean exports, they represent more than 25 percent of total exports in nine countries and more than 40 percent in countries such as Argentina, Guatemala, and Paraguay. Hence the contribution of agricultural activities to foreign exchange earnings is significantly larger than its contribution to national GDP from an *accounting* perspective. This is another reason why the sector's true contribution to national income from an *economic* perspective may also be significantly larger than its GDP share and perhaps larger than the sum of primary agriculture plus food processing industries. Other reasons include the potential for intersectoral technological spillovers and the release of production factors accomplished through technical improvements in agricultural production. The evidence regarding primary agriculture's economic contribution to national development is discussed further below.

TABLE 1.1

Commodity agricultural production values in Latin American and Caribbean (LAC) countries (percent of national GDP)

Country	Official GDP share (%) (primary agriculture + forestry + fisheries)	Plus intersectorial linkages (% of total national GDP)[a]
Chile	4.92	9.32
Colombia	14.42	18.31
Mexico	5.26	8.00
LAC average	12.00	Unknown

Source: Authors' calculations based on official data from latest available input-output matrixes, national accounts, and World Bank data.
a. Includes value of primary agriculture used in other industries.

Nevertheless, there are major drawbacks in defining and measuring rural sector size and contributions through sectoral data. Indeed, there is substantial evidence demonstrating that agricultural activities are by no means the sole or even the main income source for rural families, as shown in table 1.2. This evidence is reviewed in chapter 2 as well. An alternative rural sector definition emphasizes population density and/or geographic distance to major cities. In fact, most official Latin America statistics use various and often inconsistent criteria for determining who lives in rural communities. These criteria range from the population size of any given settlement regardless of its territorial dimension, to the extent of availability of basic services such as water and electricity. And these criteria are often used to inform decisions about critical public policies, especially the allocation of public investments across localities, despite the fact that most of the criteria are devoid of any economic rationale. In contrast, the OECD industrialized countries use internationally comparable criteria based on population density (that is, the number of people per square kilometer) and distance to major urban centers. These are economically relevant criteria because of their impact on unit costs of service delivery and market access.

Chapter 2 includes a detailed quantitative analysis that contrasts the size of Latin American and Caribbean rural populations based on official criteria with those derived using the OECD's criteria. Figure 1.1 shows the resulting estimates. For the region as a whole, the most striking finding is that the rural population is around 42 percent of the total, whereas the official statistics yield an estimate of about 24 percent. In other words, a consistent definition of rurality based on analytical criteria suggests that the region's rural population is almost double the size implied by official statistics. The differences, however, vary significantly by country. In some of the smaller countries (such as the Dominican Republic, El Salvador, Guatemala, and Trinidad and Tobago), official statistics may exaggerate the rural sector's size as compared to an application of OECD criteria.[16] In most other countries, however, official

TABLE 1.2

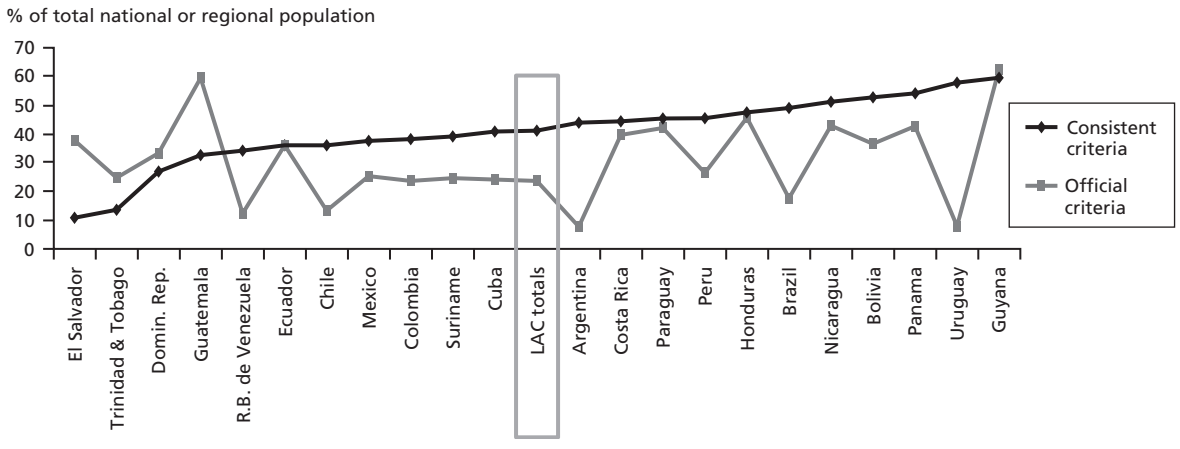
Nonagricultural income in rural Latin American and Caribbean households

Country	Survey year	Average share in total rural incomes (%)
Brazil	1997	39
Chile	1997	41
Colombia	1997	50
Costa Rica	1989	59
Ecuador	1995	41
El Salvador	1995	38
Haiti	1996	68
Honduras	1997	22
Mexico	1997	55
Nicaragua	1998	42
Panama	1997	50
Peru	1997	50

Source: Various authors, summarized in Reardon, Berdegué, and Escobar (2001). See chapter 2 for details.

FIGURE 1.1

Official and consistent estimates of the Latin America and Caribbean rural population share



Source: Authors' calculations. See chapter 2 for details.
Note: Consistent criteria applies to all countries (OECD); offical criteria varies by country. See text.

statistics clearly underestimate the rural sector's size. This is especially notable in countries such as Argentina, Brazil, Chile, Uruguay, and República Bolivariana de Venezuela. It will be important to harmonize the information categorization methods in population censuses and other survey instruments across Latin America, using economically more meaningful rurality definitions.

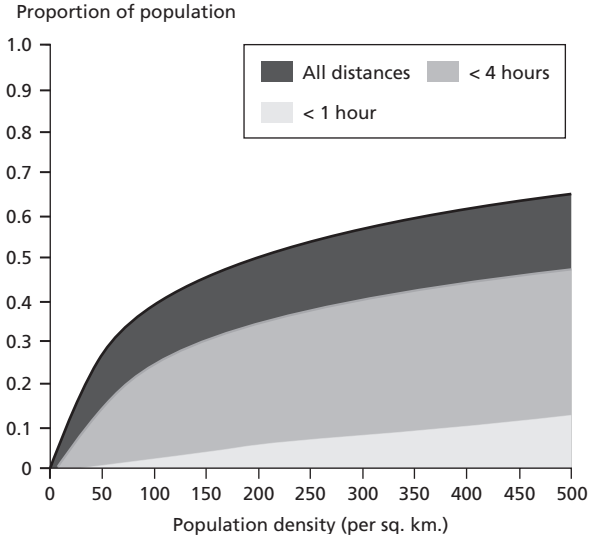
We cannot overstate that "rurality" is a multidimensional concept that encompasses access to social services and infrastructure, linkages to employment and commodity markets, and participation in agricultural and related activities. However, population density and geographic distance to major urban agglomerations affect the costs of services per beneficiary and the competitiveness of various economic activities. Thus it is also worth keeping in mind that the shift from "rural" to "urban" populations does not occur suddenly, but rather there is a rural-urban gradient that changes slowly over certain territories as shown in figure 1.2. Chapter 2 further discusses how this gradient is associated with poverty rates in a country such as Nicaragua, where off-farm employment and incomes rise with population density and proximity to major urban centers.

These findings, plus similar evidence from Mexico, led De Janvry and Sadoulet (2004, figures 1.1 and 1.2) to conclude that poor rural areas can fall under two broad categories: (a) "marginal rural areas" with low population densities characterized by long distances from major markets and/or poor agro-ecological endowments; and (b) "favorable rural areas" characterized by good agro-ecological land endowments and relatively good access to (short distances from) major urban markets. Although it is not at all clear that good arable land can attract high-paying jobs for unskilled workers in all countries—see the next section—these authors also argue that rural-urban linkages are crucial for poverty reduction. Therefore, this smooth gradient demonstrates both the policy usefulness of adopting analytical criteria for determining the size of rural populations and the need to design public policies that do not strictly target "rural" areas at the expense of "urban" areas and vice-versa. The so-called "territorial approach" to rural development is based on such considerations.

It is worth highlighting that the sectoral and demographic approaches to defining rurality are not only compatible, but should be integrated. On the one hand, as mentioned, non-agricultural incomes are above 40 percent and even 50 percent of rural household incomes in most Latin American and Caribbean countries (see table 1.2). On the other hand, there is new empirical evidence showing that total Latin American and Caribbean rural incomes do

FIGURE 1.2

Cumulative population distributions by distance to major Latin American and Caribbean cities



Source: Population and density from CIESIN 2004 (CPW v.3). See chapter 2 for details.

respond to agricultural development. The new evidence from Gasparini, Gutiérrez, and Porto (2004) is discussed in chapter 4. These authors' statistical analysis uncovered, for example, that national level use of fertilizers and irrigation is positively associated with improvements in average rural wages, thus suggesting that the sophistication of agricultural production does affect rural wages, even though many rural households do not necessarily rely on agriculture as their direct or main income source. Also, rural household studies show that incomes and productivity are jointly affected by sectoral and territorial variables, indicating that rural development policies must integrate sectoral and territorial approaches (see, among others, chapter 2; Tannuri-Pianto et al. 2004; De Janvry and Sadoulet 2004).

The relatively large share of rural household incomes from non-agricultural activities has important consequences. First, it is possible that factors such as education might have significantly larger income effects on households and therefore on rural poverty than having access to agricultural factors of production, such as land. In fact, evidence from Mexico (Taylor et al. 2004) supports this theory. Second, agriculture's contribution to poverty reduction in Latin America and the Caribbean can also be lower than that of other economic activities in rural areas or elsewhere. These issues are addressed in the next section.

2. Latin American and Caribbean agriculture's contribution to national development is about twice its GDP share

As mentioned, the sectoral rural development approach views rurality as a function of mainly agricultural economic activities. We also know that this sector's relative size in the average Latin American and Caribbean country depends on which activities are included in our definition of agriculture and related production, although such measures rarely exceed 25 percent of a Latin American or Caribbean economy. However, the aforementioned GDP shares that provide an *accounting* of the sector's size do not necessarily represent agricultural growth's true contribution to national development.

If agricultural production existed in a vacuum, completely detached from the rest of society, then agricultural production value could be used as a true indication of its contribution to national development. For example, a one-percent increase in the primary agricultural sector's size in the average Latin American and Caribbean country would contribute a 0.12 percent increase to national growth, when the sector's GDP share is 12 percent. In addition, agricultural production tends to grow slower than other sectors in most countries, and Latin America and the Caribbean is not an exception—see table 1.3. This implies that agriculture's national income share tends to decline as countries develop (see figure 1.3). However, economic development is complex and is characterized by a plethora of interconnections among workers, territories, and products. Thus it is very likely that economic and social progress in agricultural areas can have repercussions on other production processes and vice-versa, thus augmenting or reducing the impact of a given sector's expansion on national income.

Economic sectors are connected through product markets (that is, city dwellers purchase and sell goods from and to agricultural producers), factor markets (that is, capital and labor can migrate across economic sectors), and foreign exchange generation and use. National progress can depend crucially on these interconnections. Chapter 3 examines the economic relationship between agriculture and related activities and the rest of the Latin American and Caribbean economy. We conclude that during the past 40 years or so, Latin American and Caribbean agricultural growth has been associated with additional positive effects on the rest of the economy, whereby a one-percent growth in agricultural GDP was associated with about a 0.12 percent growth in non-agricultural production[17] (see figure 1.4). This result implies that the long-term relative decline of the Latin American and Caribbean agricultural sector's size is a sign of strength; it is due, at least partially, to agricultural growth's positive effects on the rest of the economy. Thus as agricultural productivity increases, the rest of the economy grows. At the same time, we did not find significant positive feedback effects going from Latin American and Caribbean non-agricultural activities to agriculture during the past 40 years.

It must be noted that these results vary widely among countries. In particular, unsurprisingly, we find that the effects of the expansion of agricultural activities on other sectors' growth is larger in countries such as Chile, with larger forward linkages and larger net exports of agricultural products.

As shown in figure 1.4, the Latin American and Caribbean results differ from those of developed countries. Other developing countries seem to have experienced similar positive effects from agriculture on their overall

TABLE 1.3

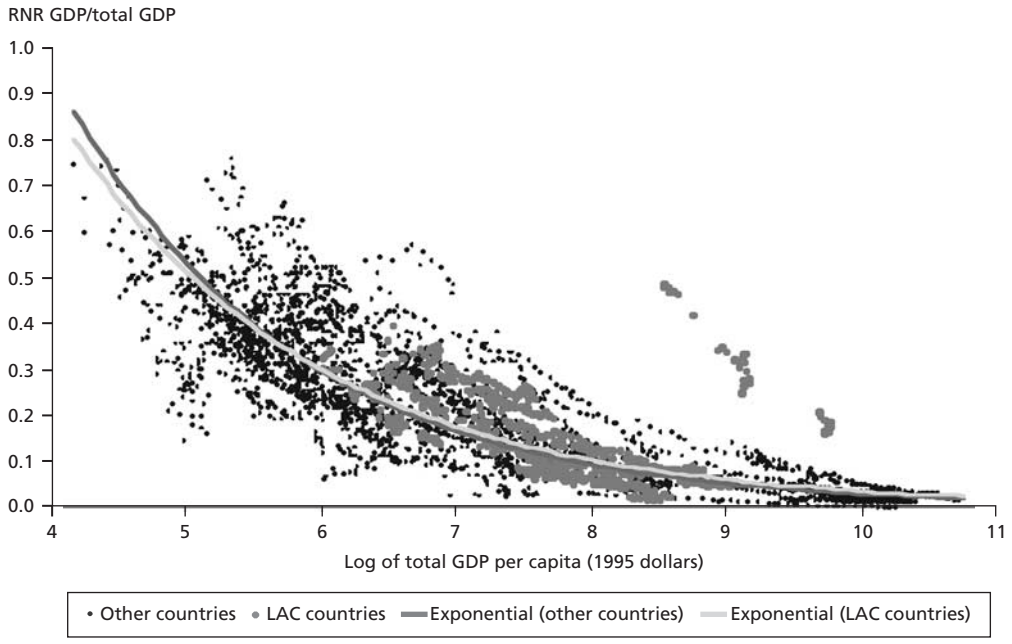
Agricultural and nonagricultural GDP growth rates (annual averages for 1970–99, data at constant 1995 dollar exchange rate)

Country	Agricultural growth (%)	Nonagricultural growth (%)
Argentina	2.3	2.0
Brazil	3.5	4.3
Chile	3.2	4.5
Colombia	1.9	4.3
Costa Rica	3.4	4.7
Dominican Republic	2.5	5.5
Ecuador	0.7	5.1
El Salvador	0.9	2.4
Guatemala	2.9	3.7
Guyana	2.1	–0.1
Honduras	2.4	3.9
Jamaica	1.6	0.6
Mexico	2.1	4.0
Nicaragua	1.2	0.4
Paraguay	4.2	4.8
Peru	2.1	2.2
Trinidad and Tobago	–1.0	3.2
Uruguay	1.1	2.2
Venezuela, R.B. de	2.2	1.8
Latin America and Caribbean average	2.1	3.1

Source: Authors' calculations based on data from the World Bank and FAO. See chapter 3 for details.

FIGURE 1.3

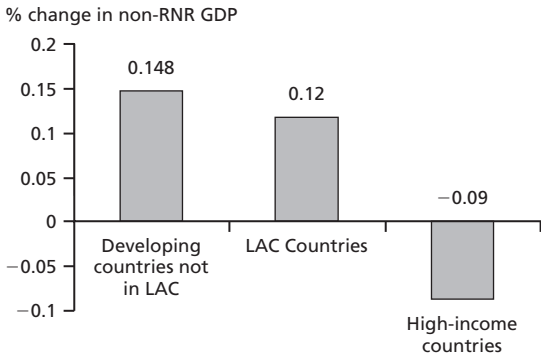
Agriculture's GDP share diminishes as countries develop (RNR sectors' GDP share and income per capita, 1960–2002)



Source: Authors' calculations based on data from the World Bank and FAO.
Note: LAC = Latin America and the Caribbean.

FIGURE 1.4

RNR growth has positive effects on the overall economy in developing countries (impact of a 1 percent increase in RNR GDP on the rest of the national economy the following year)



Source: Econometric estimations by Bravo-Ortega and Lederman (2005), based on data from the World Bank. See chapter 3 for details.
Note: LAC = Latin America and the Caribbean.

economies, but non-agricultural growth in the non-Latin American developing countries has been associated with agricultural declines, thus suggesting that non-agricultural growth pulls resources out of agricultural production (see table 1.4). In contrast, industrialized high-income countries experienced notable resource-pull effects, whereby agricultural development reduced non-agricultural production values, which suggests that excessive agriculture protection and subsidization in OECD countries leads to growth costs for their national economies, not to mention the negative consequences for developing countries with high agricultural export potential (see below). Table 1.4 (first row) provides our estimates of the magnitudes of these intersectoral growth effects for the three groups of countries.

Chapter 3 also studies agricultural and non-agricultural development's effects on other social development indicators; table 1.4 reports the corresponding estimates. Thus our analysis of the rural national development contribution goes beyond the standard economic approach that focuses almost exclusively on national income or GDP.

TABLE 1.4

Direct and indirect effects of a one-percent agricultural output increase

		LAC		High-income countries		Other countries	
		Ag	*Non-Ag*	*Ag*	*Non-Ag*	*Ag*	*Non-Ag*
1	Contribution through GDP	0.22	0.88	–0.05	0.97	0.34	0.74
2	Contribution through income of the poor	0.28	0.77	–0.08	0.90	0.46	0.58
3	Contribution through air pollution	–0.02	–0.18	0.03	–0.29	–0.06	–0.08
4	Contribution through freshwater withdrawals	–0.21	0.00	–0.25	0.00	–0.09	–0.06
5	Contribution through deforestation	0.00	0.00	0.00	0.00	–0.04	0.05
6	Contribution through environmental index (1/3)•((3)+(4)+(5))	–0.08	–0.06	–0.07	–0.10	–0.06	–0.03
7	Contribution through macro volatility	0.04	0.04	–0.01	0.07	0.05	0.01
8	Contribution to national welfare (e.g., weights: (1)+(2)+(6)+(7))	0.12	0.41	–0.05	0.46	0.19	0.33
9	Contribution to national welfare (GDP=40 percent, others 20 percent)	0.14	0.50	–0.05	0.56	0.16	0.41
10	GDP share (sector GDP/total GDP)	0.12	0.88	0.03	0.97	0.22	0.78
11	Ratio of welfare contribution ratio/GDP ratio (e.g., weights)	2.12		–3.84		2.12	
12	Ratio of welfare contribution ratio/GDP ratio (GDP=40 percent)	2.03		–3.14		1.35	
	Memo items: Elasticity of variable with respect to each sector						
	GDP of the other sector	0.12	0.00	–0.09	0.00	0.15	–0.17
	Income of the poorest households	0.19	0.77	0.00	0.90	0.36	0.64
	Air pollution (CO_2 emissions)	0.00	1.04	0.00	0.38	0.38	0.74
	Freshwater withdrawals	1.40	0.00	1.66	0.00	0.66	0.65
	Deforestation	0.00	0.00	0.00	0.00	0.04	–0.05
	Macro volatility	–0.039	–0.041	0.01	–0.07	–0.05	–0.02

Source: Bravo-Ortega and Lederman 2004a, table 7. See chapter 3 for details.
Note: Ag = agriculture; Non-ag = non-agriculture; LAC = Latin America and the Caribbean.

Poverty

Income inequality is an important aspect of national development, particularly the income of the poorest households (de Ferranti et al. 2004). Our estimates suggest that the primary agriculture sector's expansion has a smaller poverty reduction effect than other sectors' growth in the average Latin American and Caribbean country. Indeed, agricultural development, on average, helps reduce poverty by raising incomes of the poor, but this effect tends to be higher for non-agricultural activities, as shown in table 1.4. This seems to be the case, on average, for Latin America and the Caribbean, high-income countries, and other developing countries.[18] Additional statistical evidence discussed in chapter 3 suggests that it is difficult to reject the possibility that agriculture's poverty-reducing effect is similar across these three groups of countries, although table 1.4 reports the region-specific estimates. The results, of course, are not surprising as agriculture is a relatively small part of the overall economy. Actually, the table 1.4 numbers indicate that the effect of a one-percent agricultural output increase on poverty reduction in Latin America and the Caribbean is higher than its share in GDP.

Overall results vary widely by country. In some cases, as in Chile, the magnitude of both direct and especially indirect effects (through the growth impact of non-agricultural sectors) appears to be so large, that the total effect of agricultural activities' growth on poverty reduction is even larger than that of non-agricultural sectors, despite the larger size of the latter. Our cross-country econometric results for primary agriculture's contribution to poverty reduction in Latin America and the Caribbean are consistent with rigorous case study evidence. As discussed in chapter 3, case study evidence for Chile suggests that the strong poverty-reducing effects derive from both production agriculture and, more importantly, postharvest industries, such as selection and packing houses for fruits and processors. These downstream activities are an important source of unskilled labor demand and thus contribute to raising nationwide wages for unskilled workers (López and Anríquez 2003). In the case of Mexico, we also present evidence suggesting *rural income* (not just agriculture) growth tends to significantly reduce national poverty (Soloaga and Torres 2003). We also know from the most recent rural household survey that rural incomes in Mexico are quite

diversified. On average, agriculture provides less than 40 percent of rural household income, including all farmers and nonfarmers (Taylor, Yuñez-Naude, and Cerón 2004). (For farmers, this percentage would be higher.) Finally, a recent Brazil study by Paes de Barros (2003) also suggests that the 1990s agricultural boom by itself did not directly contribute much to poverty reduction through an increase in unskilled labor demand. Instead, the Brazil case shows that real farm wage increases were linked more strongly to changes in job and worker characteristics and household demographics such as higher levels of schooling and the experience of farm workers, labor force participation, lower household size, and significant increases in rural *nonfarm* employment.

This finding leads to an important policy question. Beyond farming's indirect contribution to poverty reduction through the sector's integration with downstream industries (which is where poverty impacts are significant), what should governments do to make primary agricultural production and rural growth in general more pro-poor? The fact that agricultural growth is not pro-poor in many Latin American and Caribbean countries seems related to higher asset and income concentration in agriculture than in other activities, underprovision of public goods in the rural space, and the fact that agriculture taxation and public expenditure incidence can be more regressive than in other sectors (see De Ferranti et al. [2004], and the evidence below on rural public expenditures). Thus, policies to make agriculture (and rural development in general) more pro-poor would include those attempting to make access to rural assets (land, education, infrastructure, and credit) more equitable.

One way to attempt more equitable land access is to implement so-called market-based land reforms to improve the dismal Latin American and Caribbean distribution of land assets and/or improve the functioning of land markets, facilitating rotation of assets, rentals, and other land access forms. Higher land taxes can have beneficial effects in this regard. However, the historical record of politically motivated land reforms has been unsatisfactory (Deininger 2003). More generally, we are cautious about the potential for dramatically improving Latin American and Caribbean agriculture's poverty-reducing effects because we did not find strong statistical differences between these effects in Latin America and the Caribbean as compared to those of other regions; hence Latin America and the Caribbean's notoriously unequal land distribution might not be the only explanation for why the incomes of the poorest households react less to agricultural growth than to the growth of other economic activities (Bravo-Ortega and Lederman 2005). Moreover, we know that Latin American and Caribbean agricultural incomes are but a small share of rural incomes.

Further, evidence suggests that broadening access to just one production asset has limited effects (thus land reform would need to be integrated with broadening access to education, technology, and credit). Taxing agricultural land and incomes more effectively and focusing public expenditures in favor of the rural poor (at present, public expenditures in rural areas are highly regressive in most countries [see chapter 5]) would be complementary policies to make agricultural growth more pro-poor. Still, redistributive policies should not be pursued at the expense of providing public goods in rural areas that are needed to increase overall agricultural productivity and that of off-farm rural activities. As we show in this report, agricultural production depends crucially on farmers' access to urban and foreign markets (affected by public infrastructure coverage), credit, and technical knowledge (see chapters 5, 6, and 7).

Environment

Regarding the environmental consequences of economic growth by sector, our evidence indicates that agricultural growth tends to deplete freshwater reserves (over- and underground), while other sectors tend to worsen air pollution. Table 1.4 reports the corresponding estimates of these effects, which are discussed in chapter 3. But, we also know from international data that deforestation has been a major concern in certain Latin American and Caribbean countries, especially those with large amounts of unexploited forests and potentially arable land. This is the case, for example, in the Brazilian Amazon. In these cases, substantial literature has documented the role played by different types of agricultural activities, especially cattle ranching. In addition, it is well known that in many countries, the expansion of agricultural activities and the price reduction of agro-chemicals have been associated with soil pollution due to the use of fertilizers and other agro-chemicals. However, evidence from Chile suggests that the large expansion in the use of such inputs in the 1990s was basically due to price reductions, while the production shift in favor of exportables actually had a dampening effect on such a trend. Chapter 3 also discusses these issues.

Overall, our conclusion is that agricultural activities can have deleterious effects on the environment, but the aggregate data does suggest that other economic activities tend

to have environmental side-effects that might be significantly worse than those produced by agriculture. In any case, the patterns of agricultural expansion, deforestation, and general economic progress can be analyzed more rigorously from the regional or territorial development viewpoint. This approach is further discussed below.

Volatility

Another important consideration in evaluating agriculture's contribution to national development has to do with its effects on economic uncertainty. In a previous report, we concluded that this was a major concern for the Latin American and Caribbean population, despite the fact that economic uncertainty at the national and household levels actually declined during the 1990s with respect to the 1980s (De Ferranti et al. 2001). However, the policy and scientific literature have not examined the sectoral sources of macroeconomic volatility. Chapter 3 examines both the magnitude of the contributions of agriculture and other sectors to macroeconomic volatility (that is, unexpected movements in national GDP) and potential determinants of agriculture's contribution to this volatility.

As table 1.4 shows, the evidence suggests that in high-income countries, agricultural growth is associated with increments in macroeconomic volatility that are larger than those caused by other economic activities. In contrast, for Latin America and the Caribbean as a whole, macroeconomic volatility does not seem to have a particular sectoral source. On the one hand, this could be due to the role played by large macroeconomic crises, such as exchange rate and financial crises that affected all sectors, thus overwhelming any contribution that might be emanating exclusively from the agricultural sector's volatility. Chapter 3 contains statistical analysis of agriculture's contribution to Latin American and Caribbean volatility, which explains why there is no simple sectoral pattern to the contribution of the region's agriculture to macroeconomic volatility. While agricultural diversification tends to reduce agriculture's contribution to volatility, at the same time increasing international trade tends to enhance the sector's contribution to economic uncertainty. Furthermore, these relationships are made more complex by the finding that international trade is associated with greater agricultural diversification, thus indirectly reducing agriculture's contribution to macroeconomic volatility. In addition, public policies can help reduce the sector's contribution to economic risk, especially policies related to financial markets, because financial development (in particular, credit and insurance) tends to be associated with greater agricultural diversification. Chapter 7 covers the public sector's role in alleviating credit-market failures.

With this evidence, we computed agriculture's potential contribution to a broad measure of development that included its contribution to national GDP per capita, but also to poverty reduction, environmental quality, and the reduction of macroeconomic risk (see table 1.4). Our calculations and methodology are discussed in chapter 3. For high-income countries, which tend to justify agricultural protectionism on various potentially spurious arguments, our evidence indicates that agricultural growth during the past decades has tended to reduce rather than enhance the welfare of their citizens. In contrast, primary agricultural growth's contribution to national Latin American and Caribbean well-being tends to be about twice the size of primary agricultural production relative to GDP. In other words, while the simplistic accounting of the sector implies that a one-percent increase in Latin American and Caribbean agricultural production would be related to a 0.12 percent increase in national income, our estimate suggests that its contribution to national welfare would be closer to a 0.24 percent increase. This realization can have important consequences for the overall policy framework of our countries, including tax and public expenditure policies, as discussed further below and subsequently in chapter 5. Again, country differences are large and will have significant weight in the definition of national policies.

3. While regional or territorial policies hold promise to enhance national development, they have not reduced Latin American regional disparities

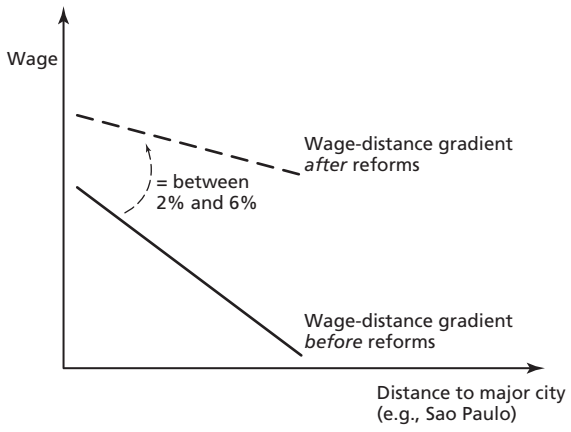
Regional policies' potential effectiveness for enhancing national development depends on whether regional or territorial characteristics affect the well-being of Latin American and Caribbean communities—as opposed to just that of individuals—in the targeted regions. For this to be true, regional policies, such as investments in the education of rural populations, must be capable of influencing the target populations' wages or employment opportunities beyond the policies' effect on each individual's educational attainment. If not, such interventions can benefit individuals but not necessarily communities as a whole or regional economies in particular. In other words, such policies must create positive regional externalities.

Chapter 4 reviews existing and new empirical evidence linking regional or territorial characteristics to community-wide wages and employment opportunities. The evidence is clear: regional policies hold some promise because community-wide outcomes affect both the number of jobs and the wages paid at the regional level. Shaping the territorial distribution of job quality and quantity in various Latin American and Caribbean countries are the following regional characteristics: distance to major cities, the adult population's average level of educational attainment, and the availability of arable land or other natural resources.

The aforementioned chapter discusses new evidence concerning regional wage determinants in Brazil. An important finding is that distance to Sao Paulo matters for wages, but its importance declined during the economic reform period that began in the early 1990s. Figure 1.5 illustrates the empirical evidence. The downward solid line depicts the relationship between wages and distance to Sao Paulo, whereby workers employed in industries in regions far away from this city tended to get paid less than similar workers in closer locations. The statistical analyses discussed in chapter 4 indicate that after the economic reforms, this negative relationship became less dramatic, as shown by the rotation of the solid line towards the dotted line. Our estimates suggest the effect of this distance became less severe and declined somewhere between 2 and 6 percent between 1988 and 1999.

FIGURE 1.5

Geographic distances to major cities relative to wages after economic reforms in Brazil



Source: Authors' calculations based on econometric evidence from Bravo-Ortega and Lederman (2004b). Underlying data come from Brazil's PNAD household surveys from 1984–99. See chapter 4 for details.

Similar evidence was found for Argentina, Brazil, and Mexico regarding the quantity of employment opportunities. That is, after the reforms implemented in these countries, especially the opening to international trade, the handicap of localities far away from major cities (that is, Buenos Aires in Argentina, Sao Paulo in Brazil, and the Federal District in Mexico) became less severe over time, suggesting that reforms were associated with a process of geographic de-concentration of employment opportunities. Nevertheless, distance to major markets still helps determine the regional wage and employment patterns observed in these and other Latin American and Caribbean countries. The relevant points of economic attraction shifted from the largest national cities to export markets. Thus international trade policy can be an important ingredient in regional development policies.

Regional educational outcomes also affect regional wages and employment. In Brazil, the evidence discussed in chapter 4 indicates that a one-percentage point increase in a state's share of skilled workers (those with a high school education or higher) is associated with a 2.5 percent increase in regional wages and a 0.12 percent increase in a state's employment share, after controlling for the characteristics of workers and industries. However, we did not find evidence that regional educational outcomes affect regional employment opportunities in Argentina or Mexico.

The existence of arable land and other natural resources also helps attract employment to rural areas. As discussed in chapter 4, empirical evidence suggests that endowments of arable land generate employment and raise regional wages in Brazil, but not necessarily in Argentina or Mexico. But mining reserves do attract employment opportunities in Argentina and Mexico. Consequently, natural resources, including land, should be considered key sectors for the development of laggard regions or territories in Latin American and Caribbean countries, but they should not be viewed as a panacea for the development of rural areas, since the evidence is mixed (probably because areas with good land, but far away from consumer or export centers, cannot use it in a competitive way). In addition, there may be other less obvious assets, such as natural beauty and environmental assets, that benefit not only local popula-

tions, but also the rest of the Latin American and Caribbean national populations (and beyond Latin America and the Caribbean), that could contribute to their conservation and use. These assets should also be considered in designing public policies that aim to support the development of poor regions, as we discuss below. However, while the fact that regional characteristics affect wages and employment holds promise for regional development policies (RDPs), it does not necessarily imply that historical experiences with RDPs in Latin America and the Caribbean have been effective.

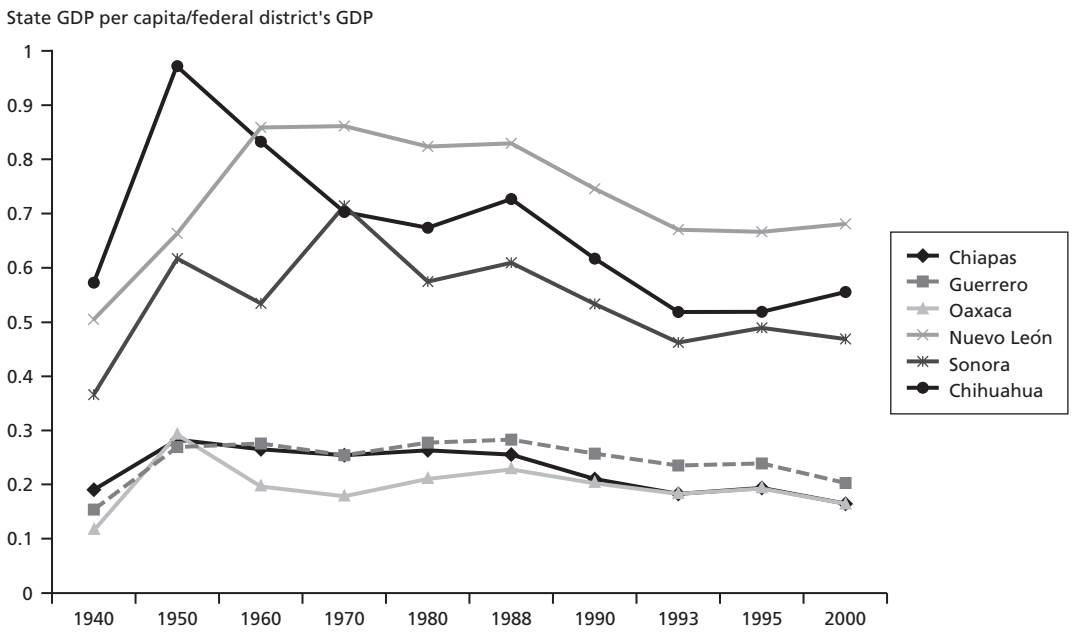
There are various types of RDPs that have been tried in Latin America and the Caribbean for some time, ranging from fiscal (tax) incentives to promote private investment in particular regions, to attempts by central governments to coordinate a plethora of incentives that various government levels provide. Chapter 4 reviews the theoretical literature that has provided the rationale for alternative approaches to public policies that target development of poor regions. In turn, chapter 9 reviews various Latin American and Caribbean experiences and the European Union's experience.

The fact that most countries are still struggling with notable inter-regional income and employment disparities suggests that RDP experiments in most countries, which date back several decades, have not been fully satisfactory. For example, figure 1.6 depicts the long-standing development gaps that exist between Mexico's southern states (Chiapas, Guerrero, and Oaxaca) and some northern states and the Federal District. Figure 1.7 illustrates the case of inter-regional disparities in Colombia over 35 years; it shows that the relative underdevelopment of the Caribbean region has been quite persistent. Similarly, there is convincing evidence suggesting that inter-regional economic convergence in Brazil (Magalhaes et al. 2000) and Chile (Soto and Torche 2002) has been quite slow during the past few decades.

Moreover, to our knowledge, there are no rigorous evaluations of RDPs' impact. The following paragraphs describe some of the attempted policies.

FIGURE 1.6

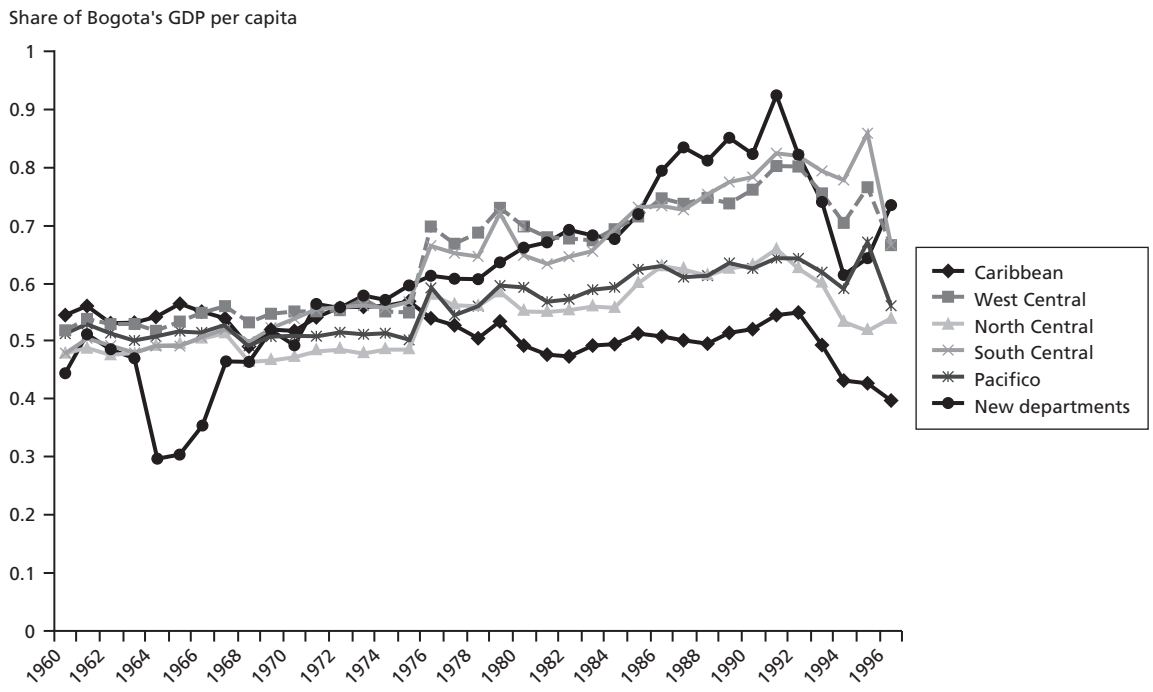
Mexican state GDP per capita relative to the federal district, 1940–2000



Sources: Lederman, Maloney, and Serven (2004, chapter 2), based on data from Esquivel and Messmacher (2003).

FIGURE 1.7

Regional GDP per capita in Colombia as a share of Bogota's, 1960–96



Source: Authors' calculations based on official data presented in Bonet (2004).

Fiscal incentives

Most Latin American and Caribbean countries have used various fiscal incentives to promote regional development. In Argentina, most provinces have in place one form of incentive or another, ranging from tax breaks to production subsidies, including establishing export processing zones (EPZs) (see chapter 9). There has been very limited evidence that supports the use of these types of incentives to promote regional development. New evidence that Sanguinetti and Volpe (2004) provide, discussed in chapter 4, does suggest that some provinces in Argentina were able to attract industries through such fiscal incentives during 1974–94. But the industries that are attracted by such incentives tend to be of the "footloose" kind, and we have seen no evidence that the promotion programs help promote national welfare. Rather, it is likely that such special regimes have flourished in almost every Argentine province, thus suggesting that a race to the bottom in fiscal responsibility could be an undesirable side effect of such programs.

Likewise, EPZs and other fiscal incentives such as wage subsidies and sales subsidies have been important components of Chile's overall policy towards its so-called "Extreme Zones" (*Zonas Extremas,* ZE, in Spanish). These fiscal incentives were complemented by raising the allocation of public investments in the target regions, including the provision of public housing. These regions (mainly regions I, XI, and XII in Chile's regional coding) continue to be considered of geo-strategic importance for Chile and are located in the extreme north and south of the country, in areas that have been characterized by border disputes with its neighbors. A recent study by Rojas et al. (2004) shows that the fiscal costs of Chile's EPZ benefits, including forgone tax revenues plus public subsidies and expenditures, was over $420 million in 2001 alone. This number implies a total cost per capita in the ZEs that exceeds $630 in 2001 or that such expenditures exceeded 10 percent of the national population's average income; thus these are not trivial fiscal costs, whereas the policy's effects have not yet been properly evaluated. It is quite likely that the fiscal costs of tax incentives and subsidies in other countries that aim to help regional development are also quite high, and they still remain unevaluated.

Key sectors and clusters

Beginning in the late 1950s, Brazil focused fiscal incentives and public investments on developing manufacturing industries in the northeastern states, hoping that transforming the northeast's productive structure would lead it to overcome its development gap. In a sharp reversal in the 1990s, promoting agricultural production by expanding the agricultural frontier became a key ingredient in the country's regional development strategy.

Magalhaes, Hewings, and Azzoni (2000) provide empirical evidence that shows that the pace of inter-regional convergence was faster during 1980–95 than during the 1970s, although during 1970–95 the pace of convergence (or the rate at which the poor states catch up with the rich states, such as Sao Paulo) was very slow, at about 1 percent per year. In fact, these authors as well as Laurini, Andrade, and Valls (2004) found that Brazil might be experiencing a phenomenon known as "convergence clubs," whereby northeast states and municipalities are growing at similarly slow rates, while at the same time the states in the southeast and central Brazil are converging to development levels that are significantly higher. In other words, after a long history of public interventions justified by the goal of raising the relative development of Brazil's northeastern states, the reduction pace of inter-regional disparities has remained anemic at best.

In recent years, establishing production clusters inspired by the work of Harvard's Michael Porter and others has been in vogue in the Andean countries and in Central America. At this time it is too early to reach a firm conclusion about the wisdom of pursuing policies that aim to improve the production linkages across vertically-integrated industries. One reason why this approach might not be as successful as expected is that such production chains can be fragmented, not only across regions in countries, but also across countries. And this production fragmentation can be economically efficient. However, if domestic production chains are underdeveloped due to poor domestic infrastructure, for example, then the public sector might have an effective role to play. But this is not the main focus of the key sectors or production clusters' programs that have been tried in various Latin American and Caribbean countries. In fact, public infrastructure and other public goods remain significantly undersupplied in the Latin American and Caribbean rural sector as discussed below and in chapters 5 and 7. There are stronger arguments, though, to support "innovation clusters" (for example, the joint efforts by complementary or competitive enterprises to develop R&D and skill formation, where considerable economies of scale and group externalities may be present).[19] However, such cases are still rare in Latin America and the Caribbean as compared with other regions.[20]

The roles of community organizations, the central government, and subnational governments in regional development policies

As mentioned above, there is a major potential role for regional and local community organizations and subnational governments in identifying regional and local specific opportunities and restrictions (as they have better knowledge of regional/local conditions) and in channeling and coordinating provision demands for specific public goods (as there is normally a need to provide or improve access to more than one public good to have a significant effect on growth and poverty reduction). The CDD experience in northeast Brazil and in other Latin American and Caribbean regions appears to give empirical support to this conceptual conclusion.

Federal and central governments also have a major role to play in the design, regulation, and coordination of territorial development policies. In fact, in the context of Latin American and Caribbean political and fiscal decentralization, the central or federal government's role in the implementation of regional development policies might actually be as important or more than in previous times. As discussed in chapter 9, even in the European Union (EU), the EU plays an important role in coordinating the various continental programs that aim to support the development of its laggard regions.

As an example, since the 1940s, the Mexican government's executive branch has been responsible for coordinating its numerous regional development initiatives. In recent years, the Mexican federal government has intensified its interest in promoting development in laggard regions. Recent initiatives include the so-called Puebla-Panama project that was expected to lead to substantial infrastructure investment in the poorest states of Southern Mexico. Even more recently, the Office of the President of Mexico proposed a novel mechanism for funding regional development investments, whereby the funds come from the federal and local governments plus other donors (including civil society organizations and private firms), but the federal government is expected to coordinate the

resulting investments and the processes through which the investment decisions are consulted among all relevant actors. Thus this model is slowly approaching the community-led development model supported by the federal government in a strong coordination role. Mexico's historical experience with the coordination of regional development programs is briefly described in chapter 9. We believe that this coordination model holds great promise, though it is not a substitute for rigorous impact evaluations of the resulting investment projects.

4. Biases in Latin American and Caribbean public policies thwart rural development

This report contains an extensive discussion of two types of biases that may work against Latin American and Caribbean rural economies. The first is related to rural policies, which seem to be excessively focused on the provision of subsidies to agricultural producers rather than on the provision of "public goods" to develop rural areas. In this regard, we use the term "public goods" to include both the provision of "pure" public goods, such as roads and other transport infrastructure, research and extension, or clean air, and other public sector interventions, such as public education and health or regulation of credit markets, that have positive effects on societies above and beyond their effects on particular families or firms. That is, we include here all forms of government interventions that resolve market failures and stimulate activities with positive externalities or reduce those with negative externalities (such as pollution). We also include targeted antipoverty programs, as poverty reduction is deemed also to be a public good, beyond its effect on individual beneficiaries. The second type of bias is related to national policies, including international trade policies and national public expenditures, in terms of their allocation between rural and urban economic activities.

Biases in rural public expenditures policies

As mentioned, important components of rural public goods are infrastructure, knowledge about production techniques and seeds, human capital, and investment in the protection of natural resources and the environment. Chapter 5 contains both macroeconomic and microeconomic agricultural productivity analyses that indicate that market access and the quantity and structure of education and infrastructure provision affect agricultural productivity at the national and household (farm) levels (see table 1.5). Chapter 6 further argues that international evidence indicates dramatic social returns to public investment in agricultural R&D,

TABLE 1.5

The effect of public goods on agricultural sector productivity

	Effect in LAC in the 1990s	Effect in the rest of the world during 1960–2000
Illiteracy	–0.024	–0.019
	0.000	*0.000*
Irrigation	0.120	0.034
	0.180	*0.560*
Roads	0.424	–0.209
	0.000	*0.000*
Telephone density	0.063	0.062
	0.140	*0.020*
Credit to private sector	0.001	–0.001
	0.150	*0.020*
Electricity generation	0.027	0.076
	0.380	*0.000*

Source: Regressions by Bravo-Ortega and Lederman (2004a, table 6). See chapter 5 for details.
Note: Effect of a 1 percent increase of each variable on the average annual growth of RNR total factor productivity; p-values of elasticities are listed in italic under each estimate. LAC = Latin America and the Caribbean.

TABLE 1.6

Estimated R&D rates of return to the agricultural sector

	No. of estimates	Mode	Mean	Standard deviation
Developed countries	78	20	66	120
Developing countries	123	40	59	38
Africa	25	30	46	27
East Asia and Pacific	38	45	77	52
Latin America and Caribbean	56	40	52	27

Source: Roseboom 2003.

and the most common Latin American and Caribbean social rate of return to R&D agricultural investments is about 40 percent (see table 1.6).

Likewise, human capital is the main productive asset for most poor people. As a consequence of credit and other market failures, however, the poor are not in general able to fully finance investments in human capital (or in new technologies), regardless of how high the rate of return to these investments might be (World Bank 2000). They are largely dependent on the public sector as a financing source for these investments.[21] More generally, rural communities face natural and economic barriers that limit their access to credit; chapter 7 discusses the potential roles that the public sector can play to improve access to credit and infra-

TABLE 1.7

Urban and rural student language attainment by education level (percent of all students with satisfactory attainment)

	Urban			Rural		
Country	Level I	Level II	Level III	Level I	Level II	Level III
Argentina	96	79	59	88	62	42
Bolivia	87	58	35	77	40	24
Brazil	95	82	58	84	62	38
Chile	95	79	60	89	63	41
Colombia	89	60	36	89	57	33
Cuba	100	98	92	100	98	92
Dominican Republic	73	44	25	73	39	20
Honduras	87	55	29	78	35	17
Mexico	89	64	43	82	48	30
Paraguay	90	67	44	81	51	32
Peru	86	57	34	71	30	13
Venezuela, R.B. de	88	60	38	84	58	39

Source: OREALC/UNESCO 2001.

structure by rural households. Likewise, chapter 8 discusses specific poverty programs that can help poor rural families maintain their children in school, so that future generations of rural communities can find their way out of poverty. Moreover, the rural poor are also highly dependent on natural resources as a subsistence source (Barbier 2004). The rural poor often disproportionately pay for resource degradation, and investments to protect natural resources and reduce environmental externalities are also a means to alleviate hardships associated with rural poverty.

Inadequate provision of rural public goods contributes to slower growth for agriculture and related rural industries. In general, many of the postharvest rural industries linked to agriculture are highly intensive in unskilled labor, which is the principal resource of the poor, and in many developing countries the rural sector's share in the unskilled labor market is sufficiently large to influence significantly the real wages for unskilled workers at the national level. A growing rural sector is thus an employment source for unskilled workers, plays a role in raising wages, and consequently is a source of poverty alleviation, even if most of the action in this regard takes place in postharvest and off-farm rural activities and not in primary agricultural activities, as discussed above.

Evidence discussed in chapter 5 suggests that rural communities in most Latin American and Caribbean countries suffer from suboptimal investments in the provision of public goods such as public education, infrastructure, research and extension, and environmental protection (see, for example, tables 1.7 and 1.8), while at the same time there are large and largely inefficient and inequitable government expenditures in private subsidies in favor of specific producers that should be redirected towards the provision of public goods. On average, across the nine countries for which data is available, between 1985 and 2000 more than 54 percent of total rural expenditures were for private goods and transfers that have no significant externalities and that benefited mostly medium-size and large producers (see table 1.9). Although the government expenditures level and composition have changed significantly over the period (the share of

TABLE 1.8

Latin American and Caribbean differentials in access to safe water

	1990		2000	
	Rural	Urban	Rural	Urban
Honduras	78	89	81	95
Jamaica	87	98	85	98
Mexico	52	90	69	95
Nicaragua	44	93	59	91
Panama	. .	. .	79	99
Paraguay	46	80	59	93
Uruguay	. .	. .	93	98
Venezuela, R.B. de	. .	. .	70	85
Latin America and the Caribbean	57.82	92.41	65.36	93.95

Source: World Health Organization and UNICEF, cited in World Bank 2003a.

TABLE 1.9

Composition of rural public expenditures

Countries	Subsidies ($ millions)	Subsidies as % of total expenditure	Public goods ($ millions)	Public goods as % of total expenditure	Total expenditures ($ millions)
Costa Rica	41.6	47.4	46.1	52.6	87.7
Dominican Republic	174.6	65.4	92.2	34.6	266.8
Ecuador	89.8	67.3	43.61	32.7	133.4
Honduras	3.3	10.8	27.6	89.2	31.0
Panama	82.9	80.8	19.6	19.2	102.5
Paraguay	106.5	86.5	16.6	13.5	123.1
Peru	197.3	55.0	161.4	45.0	358.7
Uruguay	7.7	19.1	32.42	80.9	40.1
Venezuela, R.B. de	283.8	54.2	239.9	45.8	523.8

Source: López (2004) based on data supplied by FAO, Regional Office for Latin America and the Caribbean, Santiago, Chile.

private subsidies declined notably for most countries[22] and for the five-year period, 1985–90, across all countries fell from 60 percent to 44 percent for 1995–2000), remaining shares are still excessively high.

Statistical evidence that López (2004) provided for this report indicates that this poor allocation of rural expenditures has severe consequences. For example, it suggests that an increase of one percentage point in the share of rural public expenditures dedicated to the provision of public goods in Latin American and Caribbean countries is associated with a per person agricultural production growth of about 0.23 percent. In contrast, increasing total rural expenditures by one percent without changing its composition raises agricultural incomes by only 0.06 percent. Thus the restructuring of public rural expenditures must take precedence over increasing total rural expenditures, although our estimates suggest that, once this is done, national development in the future will benefit from overall rural expenditure increases, as they will be mostly dedicated to the provision of rural public goods. Indeed, we found evidence of an overall pro-urban bias in the allocation of total public expenditures, as shown below.

Remaining antirural biases in national (and international) public policies

One of the most sensitive issues that we tackle in this report concerns the structure of public policies in terms of their potential effects on rural and urban economic activities. An important set of policies concerns international trade barriers, which can have consequences for the allocation of productive resources across agricultural and non-agricultural activities. A second set of issues concerns the global allocation of public expenditures between rural and urban areas.

Agricultural trade and the structure of import tariffs

Chapter 6 provides a detailed discussion of the potential effects that agricultural protectionism in OECD countries has on various Latin American and Caribbean countries as both as importers and exporters, especially import restrictions and subsidies offered to agricultural producers. The Latin American and Caribbean region is very heterogeneous; while agricultural exports are a significant foreign exchange source for most countries, a high proportion of countries are net food importers. The existing evidence suggests that the impact of OECD agricultural trade reforms would have different effects on Latin American and Caribbean countries depending on their individual trade patterns. Overall, OECD import barriers seem to be more important than OECD domestic subsidies for Latin American and Caribbean agricultural exports. The removal of rich-country protectionist measures can also have different effects on national economies, depending on whether a country is a net exporter or net importer of the protected commodities. As chapter 6 shows, 15 of 22 Latin American and Caribbean countries examined are net food importers; these import prices will rise when OECD farm-sector protection is reduced (see table 1.10).

Thus it is difficult to generalize about the potential effects that global trade reforms or regional trade agreements might have on the Latin American and Caribbean

TABLE 1.10

Latin American and Caribbean countries are net agricultural exporters, but many are net food importers

	Food exports and imports EX/IM	All agricultural exports and imports EX/IM
South America		
Argentina	24.2	12.5
Bolivia	1.1	1.7
Brazil	2.8	4.2
Chile	0.6	2.7
Colombia	0.5	1.9
Ecuador	0.4	3.4
Paraguay	2.2	1.7
Peru	0.1	0.7
Uruguay	6.5	2.6
Venezuela, R.B. de	0.1	0.2
Total South America	2.4	3.2
Central America and Mexico		
Costa Rica	0.9	3.3
El Salvador	0.4	0.7
Guatemala	0.9	1.8
Honduras	0.2	1.3
Mexico	0.2	0.7
Nicaragua	1	1.4
Panama	0.3	0.8
Total Central America and Mexico	0.3	0.9
Latin America and the Caribbean	1.1	1.8

Source: Authors' calculations based on FAO data.

region's national economies. Countries such as Argentina and Brazil would undoubtedly gain from the removal of worldwide agricultural trade barriers and domestic subsidies in OECD countries. But many countries that are net importers of protected or subsidized products might experience deteriorations in their terms of trade if prices of some imported agricultural commodities rise as a consequence of trade reforms. Thus, we argue that, given the enormous potential contribution to national growth of agricultural exports, trade negotiations should focus more on achieving broader market access and reducing those domestic subsidies that reduce or impede market access of potentially competitive sectors, while at the same time "buying time" and putting in place programs to support the restructuring of small domestic producers in importing sectors that would not be competitive even with a reduction of OECD domestic subsidies (see below).

Latin American and Caribbean policy makers can address an important source of sectoral biases in trade policies directly—the structure of Latin American and Caribbean trade barriers. Chapter 7 analyzes one protection measure, namely the tariff schedules that countries report to the World Trade Organization (WTO). Contrary to the widespread image of an unprotected, competitive, export-oriented agriculture in Latin America, MFN tariffs for agricultural and food product imports are relatively high for many Latin American and Caribbean countries. The average tariff level for livestock is 17 percent, for crops 12 percent, and for textiles 18 percent (see table 1.11). Mexico has the highest MFN tariffs for agriculture and food products, though they have been reduced under bilateral agreements with its largest trading partners; next is Peru. Chile has the lowest tariffs, and as of 2004, its uniform MFN tariff is 6 percent, but it maintains special price-setting regimes for three agricultural commodities. Overall, crops and the wood products sectors are protected comparably less than livestock. Processed food products also receive higher protection, demonstrating the widespread phenomenon of tariff escalation in developed and developing countries. Of the various sectors, textiles are generally most protected, and industrial protection is similar to livestock and processed foods, but higher than crops.

Except for Bolivia and Chile, where uniform (and low) tariffs are the rule, the tariff data indicates that there are surprisingly high proportions of tariff peaks—that is, the number of products that face abnormally high import tariffs—in all product categories; in many cases, more than 70 percent of all category lines are affected. The highest proportion of tariff peaks is found in Argentina, Brazil, Colombia, and República Bolivariana de Venezuela. As in the case of average tariffs by product category, livestock and food products generally have a greater number of peaks as a proportion of tariff lines than crops do. Nevertheless, the proportion of tariff peaks for crops is notably high for Colombia, Guatemala, Honduras, Mexico, Peru, and República Bolivariana de Venezuela. Conspicuously, the six MERCOSUR (Southern Cone Common Market) countries (including associate members) have no crop tariff peaks, although for forestry, livestock, and processed food, there is a very high incidence of tariff peaks for this group of countries (except Bolivia and Chile). Although MERCOSUR has uniformly low crop protection, these commodities are protected by tariffs that exceed 15 percent in at least 45 percent of tariff lines in that category in the other Latin American and Caribbean countries (see table 1.12). Coupled with the significant reductions that have occurred in most countries in tariff and nontariff protection for manufac-

TABLE 1.11

Average MFN tariffs are as high in agriculture as in manufacturing

Categories	I	II	IV	X	XI	XXI.I	XXV	
Countries	Livestock	Crops	Foodstuffs, beverages, and tobacco	Wood pulp, paper	Textiles	Machinery, electrical equipment	Miscellaneous manufactured articles	Total lines across categories
Argentina	17.0	10.2	18.5	15.8	21.0	17.2	21.8	1,449
Bolivia	9.4	10.0	10.0	10.0	10.0	8.7	9.9	1,554
Brazil	16.7	10.6	18.5	15.1	20.6	18.6	21.6	1,417
Chile	9.0	9.0	9.0	9.0	9.0	9.0	9.0	1,658
Colombia	19.5	12.7	19.0	14.0	18.6	11.0	17.8	1,586
Guatemala	15.5	10.6	12.9	4.8	18.8	4.0	11.4	1,628
Honduras	15.5	11.4	15.4	5.6	17.1	4.9	12.8	1,574
Mexico	27.1	19.7	23.1	13.2	24.8	16.7	24.1	1,750
Peru	24.5	17.2	21.7	12.0	18.0	12.0	12.0	1,462
Paraguay	15.8	10.4	17.8	15.2	20.9	13.1	19.0	1,536
Uruguay	14.7	9.8	17.8	14.1	20.1	15.3	19.9	1,494
Venezuela, R.B. de	19.5	12.8	19.1	13.9	18.8	11.8	18.3	1,586
Average tariff	17.0	12.0	16.9	11.9	18.1	11.9	16.5	
Average number of tariff lines	34	66	64	100	519	658	117	658

Source: WTO.

TABLE 1.12

MFN tariff peaks (above 15 percent) are as common in agriculture as in manufacturing

Categories	I	II	IV	X	XI	XXI.I	XXV	XXI.II
	Livestock	Crops	Foodstuffs, beverages, and tobacco	Wood pulp, paper	Textiles	Machinery, electrical equipment	Miscellaneous manufactured articles	Machinery and mechanical appliances
Argentina	53	0	100	85	97	69	100	16
Bolivia	0	0	0	0	0	0	0	0
Brazil	55	0	100	80	94	86	100	81
Chile	0	0	0	0	0	0	0	0
Colombia	100	61	95	74	95	37	92	3
Guatemala	71	47	72	15	77	14	54	0
Honduras	75	46	74	15	78	15	55	4
Mexico	66	65	75	16	94	69	97	34
Peru	85	44	78	0	76	0	0	7
Paraguay	61	1	91	81	93	46	85	7
Uruguay	43	0	97	72	91	65	92	14
Venezuela, R.B. de	100	64	94	71	97	45	94	4

Source: Authors' calculations based on WTO MFN tariff data.

tured goods, the data overall suggest that the traditional bias of Latin American and Caribbean trade policies under previous import-substitution regimes in favor of manufactures (and against agriculture) has either been significantly reduced or reversed in most countries in the region.[23]

Thus there is scope for tariff reductions that might counteract the negative effects on consumers of world price increases due to global trade liberalization. Given that there is room for tariff reductions on imports—and in the context of ongoing FTAA (Free Trade Area of the Americas) and WTO negotiations that will accentuate the pressure to lower trade barriers further—one can anticipate a strong interest in possible compensation programs to cushion the transition toward a freer trade regime for producers adversely affected by tariff reductions (especially coming from FTAA) and higher world prices (if the Doha Round

succeeds). Chapter 8 addresses possible types of compensation schemes that might provide such a cushion. These should ideally combine temporary income transfers (à la Procampo in Mexico) with technical support to small farmers in these sectors to facilitate restructuring, the adoption of more productive technologies, practices, and varieties, or a shift to new activities, and improving their access to credit and consumption markets.

The structure of national public expenditures

After the rural expenditure restructuring proposed above, the efficiency of Latin American and Caribbean rural expenditures could improve and thus justify a further reallocation of total public expenditures from urban to rural areas. This conclusion is derived from the observation that national welfare is best served by an allocation of public expenditures that is driven by each sector's relative contributions to national development, as long as the efficiency of both types of expenditures is about equal.

As of 2000, the evidence discussed in chapter 5 indicates that most Latin American and Caribbean countries for which we obtained rural and total expenditure data had allocated about half the amount to rural areas that would be justified by agriculture's contribution to national development (see table 1.13). In fact, out of the 10 countries studied in chapter 5, only the Dominican Republic had a ratio of rural-to-total expenditures that was close to twice its agricultural GDP share.

However, the Dominican Republic is one of the countries with the worst distribution of rural expenditures in Latin America and the Caribbean, as over 45 percent of rural expenditures were destined for the provision of private subsidies during 1995–2000. Ecuador and Paraguay destined over 70 percent of their rural expenditures to subsidies during the same period, and thus were the worst performers out of the 10 Latin American and Caribbean countries examined in chapter 5. As a result, we cannot overemphasize the need to pursue a sequence of public expenditure reforms, whereby the first step is to improve the structure of rural expenditures; the next step should include a broader reallocation of public expenditures from urban to rural areas. Although there is a bias against rural areas in the provision of most public goods (education, infrastructure, and R&D), a simple reallocation of total public expenditures in favor of rural areas under present budgetary trends would not be efficient because a high share of rural public expenditures are subsidies to private groups, which are neither efficient nor equitable. This problem of the inefficient public expenditures structure, which would undermine the benefits of any shift in public spending toward rural areas, is explained by both political economy and institutional factors, as discussed in the first finding (p. 7).

TABLE 1.13

Public rural expenditures compared with agriculture/GDP ratios

Countries	Ratio of rural expenditure/total expenditure to agricultural GDP/total GDP
Chile	1.26
Costa Rica	0.52
Dominican Republic	2.32
Ecuador	0.02
Honduras	1.61
Panama	1.23
Paraguay	0.51
Peru	0.67
Uruguay	0.02
Venezuela, R.B. de	1.37

Source: Authors' calculations based on data supplied by FAO, regional office for Latin America and the Caribbean, Santiago, Chile, and World Bank data.

Policies for poor regions require a broad definition of "assets"

Many laggard rural regions in Latin American and Caribbean countries are poor even though they have natural assets that, in theory, should enable them to overcome poverty. The clearest example of such assets is the availability of arable land and other natural resources, such as forests and mineral riches. These assets are important for regional development because they can attract private investment and thus lead to a process of social and economic development. However, this does not always occur because complementary production factors, including labor and capital, might seek higher returns in other economic activities located in cities or other regions. A better allocation of investments in public goods between urban and rural areas and between major cities and laggard regions might change the balance for some areas, but most probably not for all.

Some laggard regions, however, can also have other less visible assets that provide significant welfare benefits for the national population, not just for the local residents. For example, some rural regions contain bodies of water that provide natural processes through which water is cleansed.

They also have natural forests that help clean the air. The value of these assets and their contributions to the well-being of society as a whole is admittedly difficult to calculate, and chapter 8 in this report covers the existing literature on these environmental services. Beyond the challenge of measuring these contributions to development, it is nevertheless quite obvious to us that the national and perhaps even the international community should pay nontrivial amounts for these services. If a serious effort is undertaken to pay for these valuable services, then the resulting resources can be used to make the necessary public investments to safeguard these assets and to provide other public goods that might help the emergence of agricultural or non-agricultural activities in laggard regions. Thus chapter 8 also covers issues related to environmental services and rural tourism, a sector that can flourish only if environmental assets are safeguarded. The report discusses the public sector's role in stimulating these types of industries, although we acknowledge that neither this, nor a better allocation of public goods, might be a viable alternative for many people in some of the poorest regions in Latin American and Caribbean countries. In these cases, there will be few alternatives to improving human capital to facilitate labor mobility in sectors or regions (domestic or international migration), as wages tend to be higher in nonfarm activities, but many of these require higher educational levels. Both off-farm employment and migration (and associated remittances) have been found to be an important strategy of poor households to increase their income levels and diversify risk.

1.3 Conclusions: The need for institutional reforms

Implementing the suggested rural policy reforms can be difficult. In particular, there might be political forces that have shaped the structure of rural policies, including the structure of public rural expenditures, through the course of history. Thus we acknowledge that certain institutional reforms and political activism might be needed to enable the restructuring of rural public policies. For example, the ministries of education, health, and public works usually undertake the allocation of public investments in the provision of public goods in the corresponding sectors of education, health, and infrastructure. These ministries are normally more responsive to the needs and pressures of concentrated and organized urban voters and interests, including those of service providers. Existing ministries of agriculture are about the only voice with a pro-rural bias in governments, but they have virtually no voice in government deliberations about how and where to spend scarce public funds for these services. Thus it is not surprising that in many Latin American and Caribbean countries, the ministries of agriculture have become a marginal ministry with the main role of representing the interests of influential agricultural producers, especially those in noncompetitive sectors. The overall process results in a highly-skewed structure of public expenditures in rural areas, with significant underprovision of public goods and huge transfers and subsidies that favor mostly large producers, especially in noncompetitive sectors, thus reducing the effectiveness and equity of rural public expenditures. We must think hard about how to reform public institutions and the political process so that rural communities get a seat at the table when the provision of public goods for rural and urban areas is decided on and avoid the capture of large chunks of public expenditures (and policies) by large agricultural producers in specific sectors.

As mentioned above, fiscal and political decentralization have taken place in the context of wide inter-regional disparities, both in terms of social outcomes (education, health, and poverty) as well as in terms of purely economic outcomes. In theory, however, increasing local oversight over government functions can also improve the quality of public services, as long as local interest groups do not capture local governments. For the same reason, we need to support community-led development strategies that involve local peasant and other communities in the decision-making process. As mentioned before, there is strong evidence in favor of the potential contribution of well designed and implemented "territorially-based" rural or regional development policies. Both community organizations and local and regional governments have a central role in identifying opportunities and bottlenecks and coordinating demand and supply of public goods. However, central governments must also strengthen their roles as regional development program coordinators, as they remain the crucial actors in the provision of key public goods (such as R&D and inter-regional infrastructure) and as territorial development and policies have inter-regional externalities. Few other institutions are better positioned to ensure that overall regional public investments are focused on the provision of public goods that can benefit not only local communities, but also the nation as a whole.

In the case of many poor and remote areas, where agricultural (that is, forestry, fishing, and mining) activities may

not be competitive even under an improved spatial allocation of public goods and sectoral policies, we must find a way for societies to pay for the delivery of environmental services (such as conservation, biological research, and rural tourism) from which all, present and/or future citizens, will benefit. And we must also facilitate the provision of human capital to all (including through targeted conditional income transfers to the rural poor) that will allow more labor mobility, across sectors or territories, for the poor and will give income support to remaining poor families.

In sum, this report argues that agricultural development and territorial development, which includes other rural activities, are not only compatible, but also need to be strengthened through smart public-sector interventions that focus on the provision of public goods in the rural space. This approach will allow rural families and communities to make their own decisions about which activities to pursue and how to pursue them as long as the public sector and the international community provide opportunities for them to overcome poverty.

This report also demonstrates that rural development is in the national interest of most Latin American and Caribbean countries. At a minimum, we hope to provoke national and international dialogues about how we can work together with governments and civil society to enhance the rural contribution to Latin American and Caribbean development. And we have a social responsibility to go beyond the traditional focus on growth and consider more the consequences of public actions for poverty and the environment.

1.4 Report organization

The report is organized in two parts: the first covers analytical issues about the rural sector's size and contribution and the potential effects of territorial development policies; the second centers on policy issues.

Part I has three chapters. Chapter 2 discusses the "real" size of the Latin American and Caribbean rural sector, both from a sectoral (activity-based) and a territorial (population-based) viewpoint. Chapter 3 estimates the contribution of Latin American and Caribbean agricultural growth to national economic growth, poverty reduction, macroeconomic volatility, environmental degradation, and welfare. Chapter 4 discusses potential effects of territorial ("regional") development policies.

Part II has five chapters. Chapter 5 identifies the determinants of agricultural productivity and growth and estimates the effects of the composition of Latin American and Caribbean rural public expenditures. Chapter 6 deals with three crucial determinants of agricultural productivity and growth: trade, research and extension, and land policies. Chapter 7 covers two important determinants of both agricultural and other rural activities' productivity and growth: rural infrastructure and rural finance. Chapter 8 deals with complementary policies related to environmental services, rural tourism, and income support schemes for the poor and for small farmers in "sensitive" sectors during trade liberalization. Finally, chapter 9 discusses different approaches to territorial development policies, summarizes Latin American and Caribbean experiences with such policies, and extracts some general lessons going forward.

Notes

1. "Agricultural activities" in this report include crops, livestock, forestry, and fisheries. This commodity-agriculture sector is referred to as the "Rural-Natural-Resource" (RNR) sector in chapters 2, 3, and 4. "Expanded" agriculture includes RNR production plus the value added by the downstream industries, such as food and processed products that use domestically-produced RNR products. This definition of the expanded agricultural sector should be distinguished from the augmented agricultural sector that IICA (2004) and other sources use, which is simply the sum of RNR gross domestic product (GDP) plus the GDP of all of the downstream industries, not just the portion that relies on domestically-produced RNR products. Some statistical analyses presented in chapter 3 do use the sum of the RNR and downstream-industry GDPs.
2. Defined as cities of 100,000 inhabitants or more.
3. National welfare defined as a weighted average of growth, poverty reduction, environmental, and volatility effects.
4. Similar results are obtained for other developing countries outside the region, but not for developed countries. In the latter case, the growth of agricultural activities appears to detract from growth and welfare in the rest of the economy, probably as a consequence of higher labor scarcity and excessive protection that these activities typically receive in OECD countries.
5. Measured as the ratio to total public expenditures/ratio of agriculture to GDP.
6. See, in particular, De Ferranti et al. (2002).
7. Referred to as the RNR sector in chapters 2, 3, and 4.
8. See, for example, the evidence presented by Lederman, Maloney, and Servén (2004).
9. Lederman, Maloney, and Servén 2004.
10. In human capital in the case of Oportunidades.
11. We estimate that the marginal income elasticity of land is close to zero.
12. De Janvry 2004.
13. See Burki, Perry, and Dillinger (1999).

14. The nine Latin American and Caribbean countries included in IICA (2004) are Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Uruguay, and República Bolivariana de Venezuela.

15. It is also noteworthy that IICA (2004) reports that GDP shares of primary agriculture plus food processing industries ranged from 20.5 percent in R.B. de Venezuela to 34.8 percent in Uruguay in 1997. This study also reports higher numbers for the GDP share of primary agriculture than our numbers, but both sets of calculations include commodity agriculture, plus forestry and fisheries.

16. It may be argued, though, that such criteria (specially the distance to a large urban center) should be adjusted by the country's relative size.

17. It is possible that the magnitude of this effect has changed over time due to trade liberalization and globalization (which tend to produce higher fragmentation of production among countries) and agriculture modernization. These two effects act in opposite directions, and it is difficult to establish robust econometric estimates of net trends.

18. The econometric analysis underlying these estimates considered each country as a separate and equal policy experiment; the regressions were not weighted by each country's population. Thus these results are not necessarily inconsistent with the fact that a large portion of the world's poor live in rural areas when one counts the rural poor in China and India.

19. See, for example, De Ferranti et al. (2003).

20. Chile being a probable exception, with successful government R&D support of the salmon industry and other cases.

21. Public support of human capital formation for the poor can either be in the form of the direct government provision of education and health care services, or in the form of vouchers and other transfers that allow access to privately provided services.

22. Only Paraguay experienced an increase in the share of subsidies between the two periods.

23. There is evidence that in some countries such a bias against agriculture may have never existed (see Kalmanovitz [2004] for Colombia).

PART I

The Rural Contribution to Development: Analytical Issues

CHAPTER 2

How Do We Define the Rural Sector?

TO UNDERSTAND THE RURAL ECONOMY'S NATIONAL DEVELOPMENT ROLE, THIS CHAPTER presents an overview of particularly relevant areas of the Latin American and Caribbean rural economy. The rural economy is more than agriculture; it includes forestry and fisheries production and other economic activities that take place in nonurban areas. There are at least three ways of describing the rural economy: a sectoral approach, which emphasizes the sector's contribution to national GDP; a household income approach that includes farm and nonfarm activities; and a territorial approach that examines rural space more generally, in terms of population density and distance from cities.

From a sectoral perspective, as a country develops one expects increasing intersectoral integration due to forward and backward linkages between the rural natural resources (RNR) sector and the rest of the economy. What is the magnitude of the links between RNR production and the rest of the economy? What is its share of international trade? If there are substantial links, "agriculture" developments would influence developments in related sectors and thus have a higher impact on the overall economy than is captured by agriculture's GDP statistics.

Looking beyond the perspective of sectoral production, rural areas comprise a diversity of activities beyond agricultural production. Taking a purely sectoral perspective would be incomplete, because a high proportion of households in rural areas have income sources that are not directly agriculture-related. As we will see below, there is a large amount of rural non-agricultural employment and income in the region, based on official definitions of rural populations.

This is significant, because rural nonfarm employment represents an increasingly important part of the rural economy in terms of income, employment, poverty alleviation, and economic development.

From a social perspective, what criteria would permit the separation of rural and urban spaces? What is typically considered rural space encompasses activities and persons located in low population density areas, usually distant from urban centers. But there is no natural dividing line or breakpoint based on a set of characteristics. The changes from very remote towns to the largest city are often gradual. But in policy formation there have to be some criteria or thresholds to guide administration. In terms of the economic efficiency of public investments, one set of critical elements that could distinguish rural areas from urban are the cost gradients of providing social services and infrastructure, which depend on population densities and distances. What is referred to as "rural" population in the Latin American and Caribbean region reflects each country's official statistics, with country-specific definitions and criteria. Criteria vary by country and are chosen without reference to an international standard.

This chapter presents an approach to defining rural populations based on density and distance from urban centers, which allows international comparisons and could provide the basis for the adoption of a common set of criteria for

defining rural areas in the Latin American and Caribbean region. And the evidence below will show that the region tends to underestimate the population size living in areas that can be reasonably called rural. Clarifying what is rural will grow increasingly more relevant to the evaluation of rural area assistance and, more important, in the promotion of greater decentralization and territorial development.

The overview presented below is an attempt to provide a descriptive profile across countries, capturing the notable heterogeneity of the region's rural economies. It lays out the basic facts regarding the rural economy's size and structure, based on various indicators. These are: the GDP share of RNR production to national GDP; RNR trade's importance and composition; rural income sources and poverty incidence; and a presentation of an approach to defining rural areas based on the number of persons living in low-density and remote areas.

2.1 How big is the RNR sector?

The direct contributions of the primary sector—namely, rural natural resources, or often "agriculture"—to the national economy are often depicted in terms of its GDP participation, its foreign exchange earnings, and its role in supplying savings and labor to other sectors.[1] These form the traditional roles of the RNR sector (crops, livestock, forestry, and usually fisheries) described decades ago, for example, in Johnston and Mellor (1961). For Latin America, the post-WWII development literature contained pessimistic assessments of the sector's potential for productivity and export growth. In addition, the sector was presumed to be unresponsive to incentives (for example, Prebisch 1959), with a perceived absence of linkages to other sectors (Hirschman 1958). This set of stylized facts led to the conclusion that spurring agricultural growth was a low priority in the search for policies that would stimulate national economic development (Lewis 1954).

Following Schultz (1964) and others, development economists changed their attitudes toward agriculture's efficiency and growth potential. Econometric analysis suggested that agriculture in developing countries was as responsive as in industrial countries and that agriculture was capable of productivity growth and responsive to technological change. With respect to the links between agriculture and the rest of the national economy, the evidence demonstrated that the farm sector could have significant multiplier effects and therefore that agricultural growth could be propagated to other economic sectors (Adelman and Morris 1973; Mellor 1976; Bell and Hazell 1980; Hazell and Haggblade 1990; Delgado et al. 1998).[2] In part because most of the above research focused on near-subsistence agriculture (primarily in South Asia), the findings concerned primarily the importance of linkages through farm-production generated household consumption, rather than through inter-industry effects.

More broadly, as countries develop and agriculture modernizes, one expects an increasing intersectoral integration along the supply chain, between industries that supply the RNR sector with inputs and equipment, and the RNR sectors that supply processing industries and the marketing and distribution sector. RNR sector development will depend on developments in these other sectors, and their development will depend to some extent on what happens in agriculture, forestry, and fisheries. The changing nature of the relationships between sectors is manifested by new technologies and new financial and business interactions. And the depth of integration will be conditioned by the economy's openness to trade, sources of new equipment and technologies, inputs, and the destination of new products. Relationships between sectors have consequences for restructuring agriculture and the rural sector more generally, in terms of the distribution of farm sizes, the crop and product mix, and the concentration of agro-processing and retail trade.

An important question, therefore, especially for middle-income countries in Latin America (where the RNR sector typically represents a small GDP[3] share), regards the magnitude of the integration of agriculture, forestry, and fisheries with other sectors relative to the primary sector's size. Are linkages between the RNR sector and the national economy relevant for development strategy? The extent of the sector's links to the rest of the economy determines its real size and importance to the overall economy.

2.2 RNR sector composition based on national accounts

What is the size of the agriculture, forestry, and fisheries sector's direct contribution to national output? The share of national GDP attributable to a broadly-defined RNR primary sector—officially called "agriculture"—varies across countries, tending to fall with the degree of a country's economic development as measured by GDP per capita (see table 2.1). Across the region, the range of GDP shares attributable to the RNR sector varies between 1.5 percent for Trinidad and Tobago to 30.8 percent for Guyana. Over time, the RNR GDP share has declined for all countries,

TABLE 2.1

Evolution of agriculture GDP in the Latin American and Caribbean region, 1990–2002

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Antigua and Barbuda	4.2	4.2	4.2	4.1	3.7	3.9	3.9	4.1	4.0	3.9	3.9	3.8	3.8	—
Argentina	8.1	6.7	6.0	5.6	5.5	5.8	6.1	5.7	5.7	4.8	5.1	4.9	10.8	11.1
Barbados	7.4	7.4	7.1	6.8	6.5	6.3	7.2	7.0	5.8	6.2	6.2	6.0	5.8	—
Belize	20.0	18.4	17.8	16.9	16.9	18.0	17.9	17.5	16.9	17.5	17.2	15.4	15.1	—
Bolivia	16.7	17.1	16.0	16.3	17.1	16.9	16.4	17.2	14.7	15.1	14.9	15.2	14.6	14.6
Brazil	8.1	7.8	7.7	7.6	9.9	9.0	8.3	7.9	8.4	7.2	7.2	6.1	6.0	—
Chile	8.7	9.9	9.9	9.2	9.4	9.2	9.0	8.4	8.5	8.4	8.5	8.8	8.8	8.8
Colombia	16.7	17.4	15.8	13.9	16.1	15.3	13.8	13.7	14.3	14.0	14.0	14.0	13.9	14.0
Costa Rica	17.9	13.4	13.3	13.0	13.4	13.7	12.8	13.0	12.8	10.5	9.4	8.6	8.4	8.3
Cuba	—	—	—	—	—	6.0	6.8	6.7	6.2	6.4	6.7	—	—	—
Dominica	25.0	23.8	22.4	21.5	21.7	18.9	19.9	19.4	18.8	18.7	18.1	17.7	18.6	—
Dominican Republic	13.4	13.9	13.6	13.3	12.5	12.6	12.8	12.2	11.5	11.4	11.2	11.4	11.8	10.6
Ecuador	13.3	14.4	12.8	19.7	16.8	16.7	15.6	15.8	13.8	11.7	10.6	9.0	9.0	9.1
El Salvador	17.1	17.1	14.2	14.0	14.0	13.4	13.0	13.4	12.0	10.5	9.8	9.4	8.7	9.4
Grenada	13.4	13.1	11.2	10.6	10.1	10.1	8.6	8.4	7.9	8.1	7.8	7.8	7.5	—
Guatemala	25.9	25.7	25.3	24.9	24.5	24.2	24.1	23.7	23.4	23.0	22.8	22.6	22.5	22.3
Guyana	38.1	38.4	40.8	36.2	37.0	41.2	38.9	35.4	34.6	34.6	31.1	30.3	30.8	—
Haiti	—	—	—	—	—	—	32.9	31.7	30.9	29.7	28.5	28.6	27.1	—
Honduras	22.4	22.7	20.4	20.6	24.3	21.5	22.3	23.0	19.1	15.9	16.4	14.0	13.4	13.5
Jamaica	7.1	7.2	8.2	8.0	8.8	9.0	8.4	8.0	7.8	7.3	6.7	6.6	6.0	5.3
Mexico	7.8	7.5	6.7	6.3	5.7	5.7	6.3	5.7	5.3	4.7	4.2	4.2	4.0	4.0
Nicaragua	31.1	29.1	29.7	29.7	32.4	32.6	32.6	32.6	32.4	31.6	18.6	17.7	18.0	17.8
Panama	9.5	9.0	8.1	7.7	7.6	7.6	6.7	6.2	6.0	5.9	5.7	5.7	5.7	5.6
Paraguay	27.8	26.6	24.5	24.5	23.7	24.8	25.4	24.5	24.3	21.9	20.4	21.4	22.0	21.0
Peru	8.5	8.4	8.5	9.0	9.2	8.8	9.2	8.7	9.0	8.8	8.5	8.0	7.9	7.8
St. Kitts and Nevis	6.5	6.7	7.0	6.8	5.8	5.3	5.2	5.5	4.2	3.3	2.7	2.9	3.3	—
St. Lucia	14.5	13.1	13.4	10.9	9.8	10.2	8.9	6.9	8.3	7.3	7.9	6.3	6.7	—
St. Vincent and the Grenadines	21.2	18.6	19.4	14.9	11.1	14.1	12.5	10.1	10.8	10.5	10.8	10.5	10.5	—
Suriname	8.7	9.5	11.9	19.2	17.0	14.9	16.3	12.5	9.6	9.7	11.1	11.6	11.1	—
Trinidad and Tobago	2.5	2.5	2.5	2.4	2.2	2.3	2.1	2.2	2.1	1.9	1.6	1.4	1.5	1.2
Uruguay	9.2	8.5	8.8	7.4	7.9	8.6	8.0	7.5	7.0	5.6	6.2	6.4	9.4	9.5
Venezuela, R.B. de	5.4	5.5	5.3	5.4	5.1	5.5	4.5	4.4	5.1	4.9	4.2	4.5	2.6	—
Latin America and the Caribbean	8.8	8.4	8.0	7.8	8.8	8.4	8.1	7.7	7.9	7.0	6.9	6.3	7.0	—

Source: World Bank 2003a.
Note: — Not available.

and in some cases steeply, as in Colombia, Ecuador, Mexico, and Uruguay. For the region as a whole, the share of RNR in GDP was 7 percent in 2002 compared with 8.8 percent in 1990.

In terms of RNR sector composition, although disaggregated data is not available for all countries, table 2.2 shows that across Latin America, crop production accounts for about 60 percent of the sector's GDP, while livestock production accounts for between a quarter and slightly more than one-third. Uruguay is an exception, having a notably large livestock subsector (70 percent of RNR GDP). Forestry is relatively large in a few countries—Chile, Ecuador, Paraguay, and Uruguay—and has generally grown over the last decade. Fisheries represent an important share of the RNR sector's GDP in a few countries along the Pacific coast: Chile (21 percent), Ecuador (13 percent), and Peru (9 percent).

TABLE 2.2

Agriculture, forestry, and fisheries as a percent of national GDP

Country	Year	Agriculture as share of national GDP	Subsector as share of all agriculture (percent)			Fisheries as share of national GDP	Fisheries as % of agriculture
			Crops	Livestock	Forestry		
Argentina	1993	5.0	61.4	36.8	1.8	0.2	3.3
	2001	4.5	60.8	37.0	2.3	0.3	5.8
Chile	1990	6.7	59.7	40.3	—	1.5	18.7
	1998	5.4	69.4	30.6	—	1.4	21.2
Colombia	1990	16.5	61.7	36.8	1.5	0.6	3.4
	2001	12.5	61.0	38.0	0.9	0.4	3.1
Ecuador	1993	14.5	60.4	31.5	8.1	3.7	20.4
	2001	7.8	63.4	24.9	11.7	1.2	12.9
Mexico	1993	7.6	70.8	24.5	4.7	0.3	3.2
	2001	4.0	65.0	29.4	5.6	0.1	3.1
Paraguay	1990	24.4	61.8	27.2	11.1	0.1	0.5
	1998	23.5	60.3	27.3	12.3	0.1	0.5
Peru	1990	7.2	—	—	—	0.5	6.5
	2001	7.1	—	—	—	0.7	8.9
Uruguay	1993	9.0	23.4	72.8	3.8	0.2	2.3
	2001	6.0	16.0	69.8	14.2	0.2	2.7

Source: Authors' calculations based on official data.
Note: Minerals, oil, and gas are excluded. — Not available.

Linkages with other sectors: Measuring an expanded RNR sector's GDP

The sectoral GDP estimates should be read in the light of the activities that are excluded from agricultural GDP, but that would usually be thought of as being rural, nonurban activities. For example, official national accounts would exclude from the sector such activities as commercial wineries, the off-farm selection and processing of fresh fruits and vegetables, and forestry product processing.

But more generally, the RNR sector's comparatively low and decreasing GDP share might give a misimpression as to the sector's larger importance in the national economy. In the past, agriculture was often treated as an enclave, producing most of its intermediate inputs within the sector and reaching consumers at home or abroad with relatively little intermediation by other economic activities. But as agriculture becomes increasingly more modern, it grows more integrated with other sectors, buying more intermediate inputs and selling its products as intermediate inputs in other sectors.

No sector is completely independent of the rest of the economy. There are two types of linkages between sectors:

- *Forward linkages* refer to the connection of one sector to the rest of the economy as it supplies production inputs to other productive sectors. The agriculture sector has important forward linkages, especially to the agro-industries that use farm products as their main inputs to produce processed meats, canned produce, wine, and so forth.
- An economic sector has *backward linkages* with the rest of the economy as it demands goods and services as inputs from other sectors. For example, agriculture has important backward linkages to transport, fuels, chemical, and machinery industries.

How might one measure the RNR sector's integration with the rest of the economy? A simple method would be to simply sum the sectoral GDPs of national activities related to agriculture, forestry, and fisheries to the GDP of input suppliers, processing, and the marketing chain. Table 2.3 presents just such an exercise in summing sectoral GDP for Latin American and Caribbean countries that the Inter-American Institute for Cooperation in Agriculture (IICA) undertook (2004). This generous, simple calculation produces an "expanded agricultural" Latin American and Caribbean GDP of about 30 percent of national output. A similar Furtuoso and Martins (2000) study for Brazil looks in a more detailed fashion at the size of agro-business industries specifically and

TABLE 2.3

Sum of sectoral GDPs of agriculture-related industries according to IICA, 1997 ($ billions)

Country	GDP[a] (1)	Agricultural GDP /GDP (%) (2)	Sum of linked sectors' GDP[b] (3)	(3)/ National GDP (%) (4)	(4) / (2)
Argentina	14.9	4.58	104.9	32.17	7.0
Brazil	34.0	4.31	206.9	26.21	6.1
Canada	11.5	1.83	96.5	15.29	8.4
Chile	4.3	5.61	24.4	32.06	5.7
Colombia	7.6	8.00	30.4	32.10	4.0
Mexico	17.9	4.59	95.2	24.27	5.3
Peru	4.3	6.61	20.6	31.76	4.8
Uruguay	1.2	6.16	6.6	34.75	5.6
United States	55.4	0.7	644.9	8.12	11.6
Venezuela, R.B. de	3.4	4.03	17.2	2.53	5.1
Costa Rica	2.5	11.34	7.2	32.52	2.9

Source: IICA, Dirección de Planeamiento Estratégico y Modernización Institucional. Data from GTAP 5.0 and the Costa Rica SAM of 1997 (IICA 2004).
a. Including agriculture, forestry, and fisheries.
b. Including primary sector plus food and derived manufactures.

concludes that the agro-industrial sector accounts for 27 percent of national GDP (of which primary agriculture represents 42 percent). But definitions of an "expanded sector" participation in the national economy that attributes to agriculture all of the GDP in related industries would likely overestimate the sector's integration and importance in the national economy. A simple sum of sectoral GDPs would overstate the role of domestic agriculture, because any industry's GDP could be attributable to contributions from various sectors; other activities could claim the same links as agriculture. Moreover, one should account only for domestic agricultural inputs, discounting imported agricultural products.

Although sectoral GDP estimates from national accounts ignore sectoral linkages and assign a specific value added to a country's main economic sectors, one can delve deeper into the underpinnings of national accounts and measure the RNR sector's integration with the rest of the economy by making use of the estimated relationships between sectors that underlie the official calculations of sectoral GDPs. To determine the relative size of all sectors and the transactions among them, yearly national accounts rely on infrequently updated input-output (I-O) matrices as detailed snapshots of the economy at one point in time (for example, every 10 years in Chile, but for Mexico, the I-O has not been updated since 1980).[4] From the I-O matrix coefficients, one can weight sectoral GDPs to account for domestic agriculture's participation level in the supply and demand of the production value of other sectors. This approach allows a sum of the forward and backward links over all other sectors (less agriculture) to yield an estimate of the size of the total linkages for years when I-O matrices exist (see appendix C).

TABLE 2.4

Summary of expanded agricultural GDP share estimates

Country	Official agriculture GDP share (%)	Expanded agriculture GDP share (%)	% increase in share due to forward and backward linkages
Chile 1996 I-O matrix, 2001 GDP	4.92	9.32	89
Colombia 2000 SAM matrix, 2000 GDP	14.42	18.51	28
Mexico 1980 I-O matrix, 2002 GDP	5.26	8.00	52

Source: Authors' calculations based on official data. See annex C.
Note: I-O = Input-output matrx; SAM = Social accounting matrix.

Table 2.4 summarizes the results of the I-O approach in Chile, Colombia, and Mexico, where I-O details were available.[5] For all three countries, the crop production subsector makes up the bulk of the RNR sector's GDP (see table 2.2), but the fisheries subsector is notably important in Chile, and livestock has a relatively large share in Colombia. When comparing national accounts and adjusted GDP share estimates, one observes that Chile's RNR sector expands from an official share of 4.9 percent of national GDP to an integrated share of 9.3 percent, an increase in GDP value of 89 percent. Colombia's RNR sector, which has a much larger official share of GDP, expands proportionally much less, from its official value of 14.4 percent to its integrated share of 18.5 percent, an increase of 28 percent in GDP value. And Mexico's RNR sector, with a slightly larger official GDP share than Chile's but much smaller than Colombia's, expands from an official share of 5.3 percent to an integrated share of 8.0 percent, representing an increase in GDP value of 52 percent.

For all three countries, forward linkages dominate. Backward linkages are relatively small, implying that the RNR sector demands much less in terms of the value of goods and services deriving from other sectors compared with what other sectors demand from it.

TABLE 2.5

Main forward linkages for Chile, 1996

Sector	All agricultural inputs/total inputs	National agricultural inputs/total inputs
Meat	0.736	0.7359
Sugar and starch	0.7211	0.7107
Seafood	0.6667	0.6666
Canned, as conserved fruits and vegetables	0.4759	0.4591
Dairy products	0.4383	0.4372
Milling industry	0.7369	0.4153
Alcohol and liquor	0.3622	0.362
Wood and wood products	0.3113	0.3109
Wine	0.2787	0.2784
Animal feed	0.3442	0.1767
Tobacco products	0.1599	0.1599
Restaurant services	0.1453	0.1325
Hotel services	0.0952	0.0942
Paper and paper products	0.0908	0.0908
Bread, noodles, and pasta	0.098	0.0734
Beer	0.1441	0.0659
Public education services	0.0622	0.0574
Oils and fats	0.0548	0.0548
Charcoal	0.0442	0.0442
Other diverse services	0.0384	0.035
Private education services	0.0359	0.0331
Other food products	0.1341	0.0286
Public administration services	0.0169	0.0169
Furniture	0.0134	0.013
Public health services	0.0125	0.0125
Amusement, recreation services	0.012	0.012
Rubber products	0.0944	0.0006

Source: Authors' calculations based on official data. See text.
Note: A "1" represents a sector that is certainly dependent on domestic agriculture; a "2" represents a sector with a less-certain dependence due to potential imports of raw materials; a "3" represents a sector that is certainly not dependent on domestic agriculture, although its GDP would likely fall if the domestic farm sector disappeared.

- For Chile, the RNR sector's participation in the intermediate demand of other sectors contributes 3.1 percentage points to its expanded, integrated GDP share, while backward links contribute only 1.3 percentage points.
- For Colombia, forward links contribute 3.3 percentage points and for Mexico, 1.9 percentage points; backward links contribute less than one percentage point for both countries.
- For Colombia and Mexico (as of 1980), the results reveal that agriculture was relatively more self-sufficient, producing a high proportion of intermediate inputs in the sector. These small backward links could be due to a combination of the two countries' crop mix, the choice of production techniques, and the size of the subsistence and semi-subsistence farming sector.

To investigate these linkages further, consider the table 2.5 results regarding the sectors with the largest forward links to Chile's RNR sector. A comparison of the two columns indicates the relative importance of the domestic RNR sector versus imports. When values in the two columns are approximately equal, the domestic sector is supplying all or almost all of the RNR-related intermediate inputs used by an industry.

In Colombia, forward links tend to be smaller, the most significant being forward links to the meat and fish processing sector, for which domestic agriculture and fisheries contribute less than one-third of the sector's intermediate input purchases (compared with over two-thirds in Chile's meat sector). There are also relatively strong forward links to milling and the service sector. While the individual forward links are relatively small, the final sum coming from other sectors is similar to that of Chile, in terms of GDP percentage

points (3.2 percent) that can be attributable to the expanded definition of an integrated RNR sector agriculture. The reason is that the individually smaller links are associated with sectors that have relatively larger national GDP shares.

Although much smaller, the main backward linkages are not uninteresting. In Chile, the most integrated backward-linked sectors produce a variety of goods and services: they are agro-industry (mainly animal feed); agro-chemicals; fuels; wood, plastic, and rubber manufactures; and transportation, wholesale and retail trade, and business trade services. Considering that the crop-livestock sector's GDP contribution is 3.7 percent, backward links greater than that should be considered "large." For example, the crop-livestock sector demands 5.7 percent of the intermediate demand from freight transport services, more than the relative size of the overall economy's crop-livestock sector. By contrast, in both Colombia and Mexico, backward linkages to any particular sector tend to be very small. For Colombia, the main backward links are to transport, financial intermediation, and milling products. For Mexico, the main backward links are to petroleum, chemicals and plastic products, food processing, and water and irrigation services.

Of course, this is a national level analysis, but if the data were available, it would be useful to have the linkages disaggregated at regional levels as well. Linkages between primary agriculture and other industries in some regions could represent a large proportion of the whole regional economy. By having a national average, one loses information across diverse regions, some of which would be much more RNR-sector dependent, and future work along these lines would be useful for understanding the regional importance of primary production activities.

Some caution ought to be taken in interpreting the policy implications of the estimates of the RNR sector's degree of integration with the rest of the economy. These estimates provide a snapshot of the RNR sector's "true size" and answer the questions, "How integrated is the RNR sector with the rest of the economy? How big is this sector?" As such, these estimates are related to the Johnston-Mellor view of sectoral links, showing market-mediated I-O interactions between economic activities officially separated in GDP accounting. But there are no immediate policy implications in terms of specific recommendations for favoring one sector over another.

But favoring or disfavoring the production of rural natural resources will definitely have implications for the availability and costs of raw material used in downstream industries. In addition, there is the possibility of effects on nonfarm rural employment, labor income, and poverty. For example, in northeast Brazil, the irrigation expansion policies stimulated fruit production; this had significant employment and poverty effects, not only because farms employed more workers, but also because labor-intensive post-harvest and processing activities dependent on fruit production grew rapidly (World Bank 2004). As discussed below in chapter 4, the reduction in the anti-export bias in Chile induced a change in agricultural production composition toward exportables, particularly fruits and vegetables, which incited the growth of a dynamic processing sector that uses unskilled labor intensively.[6]

The I-O approach is just one way to measure RNR sector integration and to anticipate the potential impacts on the rest of the economy from sector changes. As the next chapter will discuss, one can attack the problem econometrically, detecting through historical and cross-country data the dynamic effects of changes in the RNR sector's output on the rest of the economy. The I-O and econometric approaches are complementary and show consistent results. For example, the I-O snapshot of sectoral integration presented above shows that the Chilean RNR sector is more integrated—implying greater positive dynamic effects with other sectors—than the Mexico RNR sector,[7] which is, in turn, more integrated than Colombia's. Not surprisingly, as discussed in the next chapter, econometric results show that the Chilean RNR sector's growth has demonstrated historically greater positive dynamic effects on the rest of the economy than that of Mexico, which, in turn, has greater dynamic effects than that of Colombia.

RNR sector's importance in foreign trade: Its size and composition

This section examines several aspects of the trade pattern of goods produced in the rural natural resource sectors of several Latin American and Caribbean countries. Going beyond the unprocessed products derived from agriculture (crop and animal production), forestry, and fisheries, an RNR trade assessment should also include processed goods. One question to address is its contribution to total national exports and imports of agriculture, forestry, and fishery products. Another issue is the distinction between the net overall agricultural trade position and the net food trade position, the latter being important for understanding domestic agricultural policy debates, especially with regard to the question of national food security and food import dependence.

TABLE 2.6

Export and import shares and trade balance of rural natural resource sectors (agriculture, forestry, and fisheries) in Latin America and the Caribbean, 1999–2001 averages

	Exports	Imports	Balance	
	RNR/ TOTAL (%)	RNR/ TOTAL (%)	$Exports_{RNR}$/ $Imports_{RNR}$	
South America				
Argentina	40.4	6.75	5.77	NEX
Bolivia	29.5	12.73	1.56	NEX
Brazil	27.3	7.41	3.33	NEX
Chile	28.7	6.96	4.34	NEX
Colombia	19.8	11.75	1.70	NEX
Ecuador	—	—	4.60	NEX
Paraguay	42.4	16.92	1.55	NEX
Peru	20.5	13.12	1.39	NEX
Uruguay	31.4	12.34	2.40	NEX
Venezuela, R.B. de	1.8	10.27	0.25	NIM
Central America and Mexico				
Costa Rica	25.4	10.06	2.63	NEX
El Salvador	15.9	15.05	0.70	NIM
Guatemala	40.0	15.31	1.79	NEX
Honduras	24.4	14.93	1.19	NEX
Mexico	5.0	6.83	0.69	NIM
Nicaragua	—	—	1.43	NEX
Panama	15.1	12.55	1.06	NEX
Caribbean				
Cuba	—	—	0.99	NIM
Dominican Republic	10.7	11.97	0.67	NIM
Haiti	6.1	30.13	0.08	NIM
Jamaica	8.4	13.28	0.50	NIM
Trinidad and Tobago	5.4	11.74	0.57	NIM
United States	7.1	5.69	0.94	NIM
Canada	14.5	6.10	2.66	NEX

Source: Natural resource export and import data are from FAOSTAT.
Note: NEX represents a net exporting country, NIM a net importing country. — Not available.

TABLE 2.7

Average value of RNR and total exports per person, 1999–2001

	Value RNR exports per rural person ($)	Value total national exports per person ($)	Ratio
South America			
Argentina	2,759	805	3.43
Bolivia	136	174	0.78
Brazil	533	367	1.45
Chile	2,878	1,428	2.02
Colombia	301	381	0.79
Ecuador	564	—	—
Paraguay	102	65	1.56
Peru	770	1,564	0.49
Uruguay	4,371	1,126	3.88
Venezuela, R.B. de	161	1,175	0.14
Central America and Mexico			
Costa Rica	1,233	1,988	0.62
El Salvador	227	567	0.40
Guatemala	217	327	0.66
Honduras	193	374	0.52
Mexico	334	1,697	0.20
Nicaragua	203	—	—
Panama	404	1,171	0.34
Caribbean			
Cuba	282	—	—
Dominican Republic	187	606	0.31
Haiti	6	62	0.09
Jamaica	245	1,276	0.19
Trinidad and Tobago	694	3,354	0.21
United States	1,143	3,695	0.31
Canada	6,741	9,882	0.68

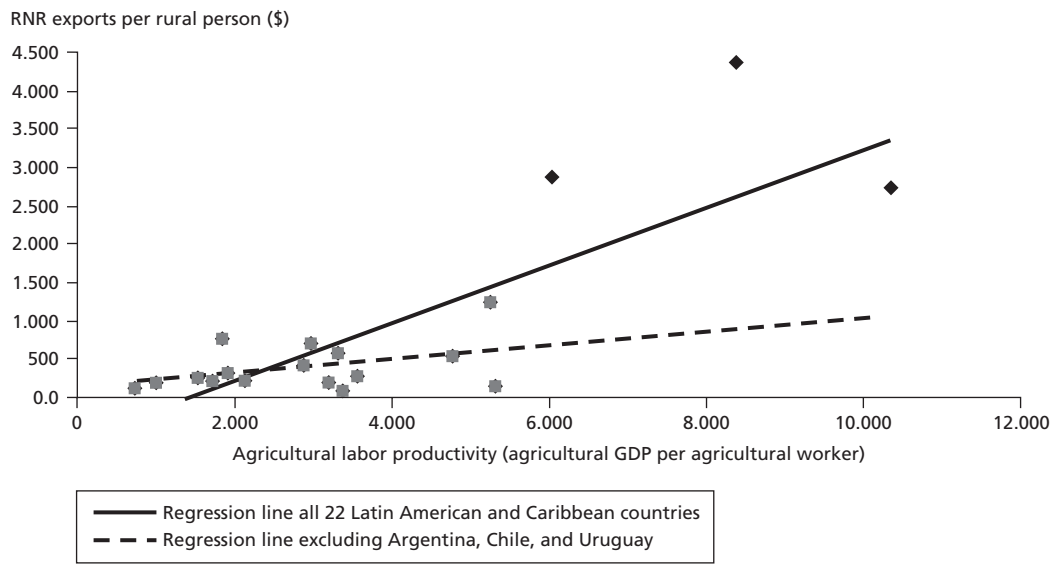
Source: Authors' calculations based on FAO trade flow data.
Note: — Not available.

Rural natural resource exports and imports

Using data for the years 1999–2001, table 2.6 reports the shares in total exports and imports of RNR products for 21 Latin American and Caribbean countries, Canada, and the United States (see also annex table A2.1 for the evolution of export trade since 1980). Renewable natural resource exports represent more than 25 percent of total export revenue for nine countries, reaching as high as 40 percent for Argentina, Guatemala, and Paraguay. The share is relatively small in the oil-exporting countries of Mexico, Trinidad and Tobago, and República Bolivariana de Venezuela, and the island nations of Haiti and Jamaica. On the import side, the shares of RNR products are generally smaller, ranging between 10 and 15 percent. Only two countries have a share greater than 15 percent—Paraguay (17 percent) and Haiti (30 percent). Of the 22 countries, 14 are net exporters of RNR products, the net importers being Mexico, Trinidad and Tobago, and R.B. de Venezuela; the Caribbean countries; and El Salvador. The region as a whole is clearly a net exporter of renewable natural resource products. Of the two industrial countries in the hemisphere, Canada, geographically large with a relatively small popu-

FIGURE 2.1

RNR exports per rural person and agricultural labor productivity, 22 Latin American and Caribbean countries, 2001



Source: Authors' calculations from FAO trade data and World Bank 2003a. See table 2.7.

lation, is also a net exporter of RNR products, while the more populous United States is a slight net importer.

As seen in table 2.7, there are striking differences in RNR export value per rural person, a measure of the contribution of rural exports to rural income. At first glance, across the region these differences appear uncorrelated with per capita income levels. A group of relatively high-income countries have high RNR exports per rural person: Argentina, Chile, Costa Rica, and Uruguay. For the middle-income countries of Brazil, Colombia, Mexico, and Peru, the RNR exports per rural person corresponds to about 20 percent that of Argentina and Chile. Are RNR exports per rural person in Latin America and the Caribbean correlated with agricultural labor productivity (for example, GDP per worker)? Figure 2.1 shows a positive correlation between exports per rural person and agricultural productivity, but this is highly influenced by the inclusion of three Southern Cone countries (Argentina, Chile, and Uruguay). If these three countries are removed from the regression, there is a much reduced correlation between agricultural productivity and RNR exports per rural person. These three countries are in temperate climates, are land abundant, have smaller proportions of their populations in rural areas, and in the past, produced products in greater demand in world markets. Taking the other Latin American and Caribbean countries together, there is a weaker relationship between agricultural labor productivity and RNR exports per rural person.

RNR export and import composition

The categories of traded goods included in agriculture, forestry, and fisheries span a large number of products that are raw, cooked, sawn, prepared, pulped, canned, frozen, fermented, bottled, and otherwise processed. For agriculture, products include oilseeds, processed oil cake and meal, milk and dairy products, fresh fruits, beverages, wines, and a variety of meat products, from fresh to canned. Hides and skin, tobacco, rubber, and textile fibers are also included. Forestry products span the gamut from logs to sawn wood to wood chips to pulp to paper to fiberboard. Fishery products include primary products from fresh and marine sources and processed fish products, canned, frozen, and meal.

As seen in table 2.8, agricultural products clearly predominate in both RNR exports and imports. Agricultural goods exported average more than 75 percent of total RNR exports. There are some notable exceptions. Fisheries represent a high percentage for three Pacific coast South American countries—Chile (27 percent), Ecuador (28 percent), Peru (58 percent)—and for República Bolivariana de Venezuela (28 percent) and Panama (41 percent). Only for Peru and

TABLE 2.8

RNR export and import shares by subsectors, 2000–02

	Exports[a] ($ millions)	Crops and animals (%)	Fisheries[b] (%)	Forestry (%)	Imports[a] ($ millions)	Crops and animals (%)	Fisheries[b] (%)	Forestry (%)
South America								
Argentina	12,073	90.3	7.4	2.3	1,532	57.0	5.5	37.5
Bolivia	429	94.0	0.0	6.0	281	82.5	2.7	14.8
Brazil	19,188	83.4	1.4	15.2	4,950	76.1	6.3	17.6
Chile	7,091	47.3	27.5	25.3	1,524	80.6	4.0	15.5
Colombia	3,222	90.8	5.9	3.3	2,019	78.1	3.9	18.0
Ecuador	2,306	69.0	28.4	2.5	601	79.1	1.4	19.5
Paraguay	561	92.6	0.0	7.4	353	87.8	0.5	11.8
Peru	2,011	36.8	58.6	4.6	1,282	82.1	1.6	16.3
Uruguay	1,206	82.8	9.1	8.1	490	79.0	3.1	17.8
Venezuela, R.B. de	536	61.5	28.3	10.1	2,192	82.7	2.9	14.4
Total South America	49,026	77.5	11.3	11.2	15,421	77.2	4.2	18.6
Central America and Mexico								
Costa Rica	1,876	90.5	8.3	1.2	804	64.5	3.3	32.2
El Salvador	578	93.2	4.9	1.9	991	83.0	1.0	16.1
Guatemala	1,484	96.7	1.7	1.7	985	80.5	1.0	18.4
Honduras	751	84.1	9.7	6.2	577	85.1	2.7	12.2
Mexico	9,140	89.6	7.9	2.5	13,826	81.0	1.2	17.8
Nicaragua	511	79.1	17.3	3.6	323	91.2	2.2	6.6
Panama	554	56.5	41.8	1.7	499	83.6	2.4	14.0
Total Central America and Mexico	15,019	88.6	9.0	2.4	18,179	80.9	1.4	17.8
Caribbean								
Cuba	900	90.3	9.7	0.0	949	89.4	4.5	6.1
Dominican Republic	597	99.7	0.2	0.1	954	72.6	6.0	21.4
Haiti	27	84.9	15.0	0.1	382	94.7	1.8	3.5
Jamaica	269	96.6	3.4	0.0	546	74.2	7.6	18.3
Trinidad and Tobago	262	94.9	4.2	0.9	451	76.4	1.8	21.7
Total Caribbean	2,540	91.0	8.7	0.3	4,636	80.8	4.8	14.4
Latin America and the Caribbean	66,575	80.5	10.7	8.8	38,190	79.3	3.0	17.7

Source: Authors' calculations from FAOSTAT.
a. Export and import data are in millions of U.S. dollars deflated by the World Bank's manufactures index (1990 = 100).
b. Fisheries are for 2000–2001. Crops and animals and fisheries sectors here comprise all primary and processed products.

Chile does agriculture's RNR export share fall below 50 percent. Chile is also notable for the size of RNR exports from forestry products (25 percent).

In the case of imports, agriculture's share averages around 80 percent for the three subregions. Unlike exports, forestry has the second largest RNR import share. The highest shares for forestry are found in Argentina (37 percent), Costa Rica (32 percent), the Dominican Republic (21 percent), Ecuador (19 percent), and Trinidad and Tobago (22 percent).

Net trade position in food and agricultural products

Table 2.9 presents agricultural product trade, distinguishing between the net overall agricultural trade position and the net *food* trade position. (The net food trade positions for forestry and fisheries sectors are in annex B.) The broad agricultural group covers the products discussed above. The food group includes cereals, dairy products, eggs, vegetable oils, meats, and sugar. The "food" concept here is broader than that used by some international agencies, such as FAO, which often excludes sugar and vegetable oils, based on a definition of "essential foods."

Notable results shown in table 2.9 are that only five of the 22 countries considered are net food exporters, all are in MERCOSUR or are associated members, and all have climate advantages for grain, oilseed, and livestock production.[8] Contrary to the common perception that Latin America is an agricultural continent, 16 of the 22 countries are net food importers; nine of these are also net importers

TABLE 2.9

Net trade position in food and agricultural products (excluding forestry and fisheries), 2000–02 averages ($ millions)

	Food exports and imports				All agricultural exports and imports			
			Net balance				Net balance	
	Exports	Imports	EX-IM	EX/IM	Exports	Imports	EX-IM	EX/IM
South America								
Argentina	5,437.4	224.7	5,212.7	24.2	10,900.0	872.9	10,027.1	12.5
Bolivia	124.8	113.4	11.3	1.1	403.3	232.0	171.3	1.7
Brazil	5,769.0	2,076.9	3,692.1	2.8	16,000.0	3,768.2	12,231.8	4.2
Chile	359.0	577.3	–218.3	0.6	3,351.4	1,228.4	2,123.0	2.7
Colombia	388.8	724.8	–336.0	0.5	2,925.6	1,577.5	1,348.1	1.9
Ecuador	71.9	189.8	–117.9	0.4	1,592.1	475.2	1,116.9	3.4
Paraguay	131.5	58.7	72.9	2.2	519.3	310.1	209.3	1.7
Peru	54.5	616.1	–561.5	0.1	739.4	1,052.8	–313.3	0.7
Uruguay	733.5	112.2	621.2	6.5	998.0	387.3	610.6	2.6
Venezuela, R.B. de	64.1	858.0	–793.9	0.1	329.6	1,813.5	–1,483.9	0.2
Total South America	13,300.0	5,643.2	7,656.8	2.4	38,000.0	11,900.0	26,100.0	3.2
Central America and Mexico								
Costa Rica	178.8	205.4	–26.6	0.9	1,698.2	518.5	1,179.6	3.3
El Salvador	136.9	374.2	–237.3	0.4	539.3	822.0	–282.7	0.7
Guatemala	346.2	384.5	–38.3	0.9	1,434.7	793.0	641.7	1.8
Honduras	51.4	216.6	–165.3	0.2	630.8	491.1	139.7	1.3
Mexico	811.0	5,385.2	–4,574.2	0.2	8,191.1	11,200.0	–3,008.9	0.7
Nicaragua	152.0	146.9	5.1	1.0	404.4	294.2	110.2	1.4
Panama	51.5	180.8	–129.4	0.3	313.0	417.3	–104.3	0.8
Total Central America and Mexico	1,763.1	6,922.8	–5,159.6	0.3	13,300.0	14,700.0	–1,400.0	0.9
Caribbean								
Cuba	504.1	598.7	–94.5	0.8	812.8	848.2	–35.3	1.0
Dominican Republic	97.3	325.0	–227.7	0.3	595.0	691.9	–96.9	0.9
Haiti	0.0	259.3	–259.3	0.0	23.2	362.0	–338.8	0.1
Jamaica	96.1	283.3	–187.1	0.3	260.2	404.8	–144.6	0.6
Trinidad and Tobago	82.6	163.5	–80.9	0.5	248.8	344.5	–95.7	0.7
Total Caribbean	847.0	2,125.6	–1,278.6	0.4	2,310.2	3,746.4	–1,436.2	0.6
Latin America and the Caribbean	15,900.0	14,700.0	1,200.0	1.1	53,600.0	30,300.0	23,300.0	1.8

Source: Authors' calculations from FAOSTAT.
Note: Export and import data are in millions of U.S. dollars deflated by the World Bank's manufactures index (1990 = 100). Fisheries data are for 2000–01. Agricultural exports (crops and animals) here comprise all primary and processed products.

of all agricultural products. In contrast to food products only, for all agricultural products there are 10 net importers and 12 net agricultural exporters compared with five net food exporters. Seven countries are both net agricultural exporters and net food importers: Chile, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, and Nicaragua.

These results are relevant for agricultural trade negotiations. The common perception is that there exists a high cost of agricultural protection for Latin American countries, based on the presumption that most countries in the region are net exporters. Protection and domestic subsidies, especially those of the OECD, reduce world prices and Latin America's export earnings, a theme that chapter 7 addresses in more detail. Net food importers benefit from protectionism and subsidy-induced lower world prices. The question of the world price effects of protection and OECD subsidies is more relevant for nonfood agricultural exports that affect many more countries (12). While it is clear why some Latin American and Caribbean countries—seeking to expand their exports—would be keen on OECD trade liberalization and subsidy reduction, the case of net agricultural importers is ambiguous.

Industrial country trade liberalization would increase world prices and thus would increase the food import bill. It is often claimed that multilateral liberalization would

TABLE 2.10

Taxonomy of Latin American and Caribbean countries, 1999–2001

	LIC	LMIC	UNIC	Total
LIFDC	2	1	0	3
NFIM	2	8	6	16
NFEX	0	1	3	4
NAIM	1	4	4	9
NAEX	1	5	5	11

Source: Authors' calculations based on FAOSTAT and World Bank 2003a.
Note: LIFDC = low income food dependent; NFIM = net food importing; NFEX = net food exporting; NAIM = net agricultural importing; NAEX = net agricultural exporting. LIC = low income (<$875 per capita); LMIC = lower middle income (<$3,125); UMIC = upper middle income (<$9,655).

raise the domestic food prices. But considering that OECD trade liberalization would require at least some degree of reciprocal liberalization in developing countries, reduced tariffs and greater market access would have a mitigating effect on domestic prices. The final result on domestic prices is ambiguous, depending on the magnitude of world price changes relative to the degree of reduced border protection in developing countries.

Based on income classifications (see annex table A2.2), table 2.10 presents a summary of the taxonomy of Latin American and Caribbean countries' net food and agriculture trade positions, classified by income levels.

A simple regression analysis of net trade position and income levels suggests that there is no systematic association between them, especially when Argentina and Uruguay are excluded from the regression line. Both countries have high incomes and high net export levels of both food and agricultural products. In terms of food imports alone, however, one would expect that as countries grow richer, food consumption patterns diversify and result in more imported food products. This is confirmed by regression analysis, which demonstrates a positive relation between per capita income levels and the food import bill per capita (total population). Relative to their export capacities, however, there does not seem to be a pattern in countries' development level and food import dependence. Again excluding Argentina and Uruguay, there is also an even more pronounced positive relation between per capita income and total agriculture import bill per person. The point is that in the case of Latin American and the Caribbean, food import levels per capita are not an indicator of excessive food import dependence, but rather are a country wealth indicator.

What are the lessons that can be drawn from this overview of the RNR trade's importance in the region?

- First, the RNR sector contributes significantly to overall national trade. RNR exports are more than one-third of export revenues in recent years, although this share has been declining. Even for countries where agriculture's GDP share is relatively low, RNR exports represent a higher total export share (for example, in Argentina, Brazil, Chile, and Mexico). Moreover, the share of RNR export trade to total trade is quite heterogeneous across Latin American and Caribbean countries.
- Second, this high degree of heterogeneity carries over to countries' net trade positions in both food and all agricultural, forestry, and fisheries products. In terms of the number of countries, there is a high degree of import dependence, which is relevant for the debate on WTO trade liberalization.

2.3 What do rural people do? Rural poverty, employment, and income sources

The rural economy is more than simply primary production activities, although a typical and prevailing view of developing countries is that rural households rely overwhelmingly, if not entirely, on farm production. Rural nonfarm income is important, however, in terms of total income levels for both farming and nonfarming households, poverty and food security, the incentives to migrate, the likelihood of resource overexploitation, and in terms of providing a source to finance farm production investments.

Rural income sources are of particular interest due to high poverty rates found in rural areas. Latin America and Caribbean poverty still affects rural more than urban populations and significantly so, although most poverty analyses have a strong urban orientation, and some countries do not even have official rural poverty statistics. The high poverty incidence in rural areas in some countries is quite dramatic, as can be seen in table 2.11. In Bolivia, Guatemala, Honduras, Nicaragua, Paraguay, and Peru, at least 70 percent or more of the rural populations live in poverty. More than one-third of the rural population lives in extreme poverty in Bolivia, Colombia, El Salvador, Guatemala, Honduras, Nicaragua, Paraguay, and Peru. Poverty determinants were addressed in a variety of micro case studies based on household surveys,[9] and latter sections of this report will address

RNR sectoral growth's role in poverty alleviation. There are three channels through which RNR sector growth can affect poverty: (1) labor income of unskilled workers (used relatively more intensively by the sector, especially in crop production); (2) low income producers' net revenues; and (3) real food prices to consumers. Nonfarm activities—perhaps connected to agriculture, forestry, and fisheries—contribute to income generation and stabilization and poverty alleviation. So how do rural people earn their incomes?

Employment and household income sources

In addition to farming, evidence suggests that significant income sources for rural households are wages, self-employment outside agriculture, and other earnings from commercial activities, manufacturing, and other services. Rural nonfarm income tends to be positively correlated with national development, and case studies indicate positive growth over time of nonfarm income as a share of total household income in rural areas. As a proportion of total employment in rural areas, nonfarm employment averages approximately 25 percent in Latin America (compared with 44 percent in Asia), which represents a lower share than nonfarm income relative to total income (40 percent) (Reardon 1998). This nonfarm employment rate in rural areas has been growing in Latin America, except in Peru (where it remains steady) and Bolivia (where it is falling). In absolute terms, rural nonfarm employment has grown in all Latin American and Caribbean countries and has grown significantly more rapidly than farm employment, which in many cases has declined in absolute terms. As a regional average, the percentage of the rural population having a rural nonfarm activity as the principal economic activity increased from 24 to 29 percent over the 1990s.

By the end of the 1990s, self-employed workers as a proportion of all rural workers represented more than 40 percent of total employment for almost all Latin American and Caribbean countries, except Chile and Costa Rica.[10] Within the self-employed group, for most countries there has been an increase—notable for some countries, such as Mexico, Guatemala, and Panama—in the proportion that are employed outside of agricultural production. In terms of all rural workers, most countries have shown an increase in the percentage of those employed in nonfarm activities, although Brazil and Nicaragua are notable exceptions. A higher percentage of all rural working women tend to work in nonfarm activities than is the case for men. For 11 of the 14 countries where survey data is available, between 65 and

TABLE 2.11

Rural poverty and indigence rates (percentage of rural population)

		Poverty		Indigence	
Country	**Year**	**Urban**	**Rural**	**Urban**	**Rural**
Argentina	1994	16.1	—	3.4	—
	1999	23.7	—	6.7	—
Bolivia	1990	52.1	—	23.3	—
	1994	51.6	—	19.8	—
	1999	48.7	80.7	19.8	64.7
Brazil	1990	41.2	70.6	16.7	46.1
	1995	32.4	58	10.8	33.2
	1999	32.9	55.3	9.3	27.1
Chile	1990	38.4	39.5	12.4	15.2
	1994	26.9	30.9	7.1	9.8
	2000	20.1	23.8	5.3	8.3
Colombia	1990	39.1	—	13.9	—
	1994	45.4	62.4	18.6	42.5
	1999	50.6	61.8	21.9	34.6
Costa Rica	1990	24.8	27.3	6.4	12.5
	1994	20.7	25.0	5.7	9.7
	1999	18.1	22.3	5.4	9.8
Ecuador	1990	62.1	—	26.2	—
	1994	57.9	—	25.5	—
	1999	63.6	—	31.3	—
El Salvador	1995	45.8	64.4	14.9	29.9
	1999	38.7	65.1	13.0	34.3
Guatemala	1989	53.1	77.7	26.2	50.1
	1999	46.0	70.0	17.2	45.2
Honduras	1990	69.8	88.0	43.2	72.8
	1994	74.5	80.5	46.0	59.8
	1999	71.7	86.3	42.9	68.0
Mexico	1989	42.1	57.0	13.1	27.9
	1994	36.8	56.5	9.0	27.5
	2000	32.3	54.7	6.6	28.5
Nicaragua	1998	64.0	77.0	33.9	57.5
Panama	1989	40.9	57.1	18.6	33.1
	1994	30.8	49.2	11.4	26.2
	1999	25.8	41.5	8.1	17.2
Paraguay	1994	49.9		18.8	
	1999	49.0	73.9	17.4	52.8
Peru	1995	38.3	65.1	11.7	42.2
	2000	36.9	70.0	4.1	35.6
Dominican Republic	1998	25.4	38.4	4.4	10.9
Uruguay	1990	17.8	—	3.4	—
	1994	9.7	—	1.9	—
	1999	9.4	—	1.8	—
Venezuela, R.B. de	1990	38.8	46.5	13.3	21.7
	1994	47.1	55.6	17.1	28.3

Source: ECLAC, División de Estadística y Proyecciones Económicas, Unidad de Estadísticas Sociales, Santiago.
Note: — Not available.

93 percent of rural working women are employed outside of agricultural production, percentages considerably higher than that of men (Bolivia and Paraguay being the exceptions, with relatively low rates). But over the decade of the 1990s, the difference between women and men decreased in several countries, due both to the increase in men and in some cases to the decline in women in nonfarm activities. The increase in the percentage of rural men working in nonfarm activities is especially large for Chile, Costa Rica, Mexico, and Panama. For all Latin American and Caribbean countries, rural men have a higher participation in the workforce than urban men, reflecting the much larger workforce participation of younger men who would otherwise be in high school and college. The disparity between the percentages of women working in urban and rural areas is notably lower for younger women than older, suggesting a shift over time that is taking some time to move through generations (Economic Commission for Latin America and the Caribbean [ECLAC]).

Nonfarm rural employment and income

The Latin America and Caribbean rural non-agricultural employment sector is large, extremely heterogeneous, and represents an important part of the rural economy in terms of both income and employment. There is a growing appreciation of this employment sector in both poverty alleviation and rural economic development. From survey analysis of rural households for the late 1990s, nonfarm income represents more than 40 percent of total household income in nine of 12 countries, and more than 50 percent for six countries (see table 2.12). Furthermore, this share has been increasing for most countries. While farm-based employment has declined, nonfarm employment has been increasing, with a net increase in total rural employment.

Analysis shows that there are two coexisting but very different types of rural nonfarm employment (RNFE) (Lanjouw 2000). One type is poorly remunerated, often receiving less than farm laborers, but it provides an income source to certain groups such as the elderly, disabled, and sometimes women. This income source is important, but it is not likely to provide upward income mobility or a means to escape poverty. The other RNFE type is in higher-productivity activities, providing income to households that offer a route out of poverty. RNFE can also be usefully categorized by whether or not income is sheltered from the agriculture economy's fluctuations. The most fortunate workers are those employed in the service sector (for example, administration and teaching), where remuneration is relatively high and unrelated to agricultural conditions. RNFE growth has derived predominately from the service sector, particularly the public sector.

TABLE 2.12

Rural nonfarm income (RNFI) as share of rural household income, 1990s

Country	Survey year	Share of RNFI in rural incomes
Brazil	1997	39
Chile	1997	41
Colombia	1997	50
Costa Rica	1989	59
Ecuador	1995	41
El Salvador	1995	38
Haiti	1996	68
Honduras	1997	22
Mexico	1997	55
Nicaragua	1998	42
Panama	1997	50
Peru	1997	50

Source: Various authors, summarized in Reardon, Berdegue, and Escobar (2001).

With respect to recent analyses, studies for Ecuador, El Salvador, and Mexico offer some insight as to rural household income sources and their determinants. In an analysis of the 2003 Mexico National Rural Household Survey (the first effort to obtain detailed production, income, time use, and expenditure data that could be generalized to the entire rural Mexican economy), Taylor, Yunez-Naude, and Ceron (2004) find that the key to economic livelihood in rural Mexico is managing diverse household assets. Although the various forms of income-generating assets are unequally distributed, different households have different asset portfolios, leading to a more equitable income distribution across rural households than would otherwise be expected from simply looking at assets. Increasingly, human and migration capital are the most important assets for Mexico's rural households; these have a role in reorienting households away from agriculture and toward the nonfarm economy. Schooling of household members is negatively correlated with rural households' participation in agriculture, but positively correlated in nonfarm activities. Physical capital for agricultural production purposes (that is, land value, farm machinery, and cattle) promotes household participation in all agricultural activities and income generated by these activities. In fact, the empirical evidence provided by Taylor, Yunez-

TABLE 2.13

Rural household income, distribution, and composition in Mexico, 2003

	South-Southeast	Center	Center-West	Northwest	Northeast	Total
Total net household income (average $)	2,740	2,828	5,235	8,784	5,435	5,347
Income sources (%)						
Farm production	8.7	11.3	11.0	24.0	27.3	18.2
Local nonfarm activities	20.6	7.5	7.4	5.0	8.3	8.3
Renewable resource extraction	6.2	4.3	2.5	0.9	0.6	2.3
Public transfers	9.9	5.1	3.9	2.0	4.9	4.4
Migrant remittances from the United States	6.7	13.0	13.8	3.6	20.2	11.0
Internal remittances	3.7	3.3	1.0	1.2	0.5	1.7
Salaries from agriculture	14.8	15.9	11.3	14.4	8.9	13.0
Salaries from non-agriculture	29.4	39.7	49.1	49.0	29.4	41.2
Total	100	100	100	100	100	100

Source: Taylor, Yúnez-Naude, and Ceron 2004; from ENHRUM 2003.

Naude, and Ceron suggests that total household income is much more sensitive to human capital and migration than to land or other agricultural assets. This is apparently due to the reduction of off-farm income associated with higher stocks of agricultural assets, whereas human capital has a large off-farm income effect that is much greater than any discernible effect that it has on reducing farm incomes.

An income breakdown by source, as table 2.13 shows, reveals the extent to which rural Mexicans currently rely on nonfarm income and the considerable regional disparities in the mix of income sources. Farm production (staples, livestock, and cash crops) represents only 18 percent of household total income, and agricultural wage work accounts for another 13 percent. Local wages from non-agricultural activities are by far the largest income share (41 percent). Average household total income is $5,357, and the distribution of this income is much more equitable than the distributions of individual assets across households.

This pattern of non-agricultural income sources seen in Mexico is confirmed by a recent study on the microdeterminants of sectoral participation and income growth of farm families in El Salvador. Tannuri-Pianto et al. examined a panel dataset of rural households for the 1995–2001 period and found strong evidence of the significant contribution of off-farm employment to rural income growth. While agricultural income grew only 1.2 percent annually, reflecting mainly the dismal performance of coffee producers between 1995 and 2001, non-agricultural income increased at a rate of 18.5 percent and remittances and transfers from relatives at a rate of 42.9 percent. The distribution of time dedicated to household labor activities shifted from 60 percent of labor hours dedicated to farming to 44 percent. As table 2.14 highlights, agriculture's relative importance in a typical household's total income went from 44.0 percent in 1995 to 26.4 percent in 2001, and the relative importance of non-agricultural sources grew significantly from 46.8 percent in 1995 to 55.2 percent in 2001. This was due mainly to rapid income growth from entrepreneurial activities (microenterprises) and transfers, especially remittances from relatives abroad,

TABLE 2.14

Income sources of rural households in El Salvador

	1995	1997	1999	2001
Household income in *colones* 2001	4,368	4,400	6,842	7,766
Income source as percent of total				
Farm (production and wage income)	44.0	37.2	28.8	26.4
Nonfarm (excluding remittances)	46.8	53.2	56.6	55.2
Remittances and family	8.1	8.8	13.5	16.3
Subsidies	1.1	0.8	1.1	2.2

Source: Tannuri-Pianto et al. (2004) from a survey of 449 rural households.
Note: Income is expressed in 2001 *colones.*

which increased its importance from 8.1 percent to 16.3 percent by the end of the period. Notably, the labor supply away from agriculture was more marked for men, while women (traditionally oriented to non-agricultural activities) shifted their labor supply from salary non-agricultural jobs to entrepreneurial activities.

The shift from traditional agriculture to off-farm productive activities in El Salvador was driven both by public policies, such as the provision of rural roads and better access to rural education, and by household's own diversification strategies, such as a shift toward nonfarm employment and migration abroad. Electricity and proximity to markets increase the probability of relying primarily on off-farm occupations, while individuals that lack them and have access to informal credit tend to remain in agriculture. The Tannuri-Pianto study also finds significant evidence pointing to important complementarities between rural investments and the potential of families to benefit from these investments, which depends on households' productive endowments, including education. This is a more general conclusion that Lanjouw (2000, 2003) derived from his detailed analyses for Brazil, Ecuador, and El Salvador. There is significant evidence of greater nonagricultural activity in those areas that are better served by rural infrastructure and in households with better education levels.[11] Better coordination of rural investments—in education, in roads with access to markets, and in credit provision—would ensure that the returns to many of these investments are realized and conditions of the poor improved.

Rural nonfarm activities are a promising means to increase rural employment and so offer a means to reducing poverty.[12] Nevertheless, a strategy to increase RNFE is infeasible in low-density remote areas, where markets are thin and poorly served by infrastructure such as roads, electricity, and communications. Beyond the general conditions of a good investment climate[13] (particularly for small entrepreneurs), there is unambiguous evidence that RNFE tends to develop in areas with better infrastructure, where factor and product markets work better and transaction costs are lower, giving more densely populated areas an advantage in the creation of such employment. RNFE generation requires good transport and communications accessibility. One of the most detailed Latin America and the Caribbean RNFE studies was done for Brazil, and its results show that better education and good basic infrastructure are the critical ingredients for nonfarm activities (World Bank 2003). The cost efficiency of providing these services depends on population densities and the remoteness of communities, two rural space characteristics that we examine next.

2.4 How many people really live in rural areas?

Just how many people live in rural areas in Latin American and the Caribbean? The Chomitz, Buys, and Thomas (CBT) (2004) background paper, from which this section is largely excerpted, argues that this question is not simple, perhaps not even well-defined. A standard answer might come from official statistics based on individual country definitions of urban and rural areas (table 2.15). In 2001, by the official count, there were slightly more than 125 million people living in Latin America and the Caribbean rural areas, which represented 24 percent of the region's total population. But each country has its own definition of what is a rural area[14] (as can be seen in table 2.16), which is typically based on identifying what does not fit a particular definition of an urban area. Moreover, these criteria have changed over time, exacerbating problems in comparing official statistics, not only across countries, but also over different census years for a single country.[15] Countries typically apply criteria based on the nature of the administrative district or on the settlement's population.[16] Some countries also apply criteria related to the presence of infrastructure and services—such as paved roads, street lights, schools, and medical clinics—usually associated with urban areas. Chile is unique in linking rurality to agriculture; it defines as rural all municipalities with less than 1,000 persons, but a municipality having between 1,000 and 2,000 persons is rural if 50 percent or more of the workforce is in agriculture. As a rough generalization, most countries will classify as "urban" any settlement of more than 1,500 to 2,000 people.

These official definitions of rurality in the region are in marked contrast to the population density rule that the OECD favors. The OECD uses a threshold of 150 persons/kilometer^2 (km) as a first step in defining the rurality of its 50,000 local communities (Bollman and Bryden 1997). Depending on the policy question's nature, the OECD also uses as a criterion the rural population's share in a larger regional unit of which the community is a part.

Rurality has many features and connotations, and the construction of an all-purpose definition applicable in all situations would be a futile exercise. The apparently intuitive dichotomy between "rural" and "urban"—evoked by

contrasting images of an isolated, bucolic farm and densely packed skyscrapers and slums—is poorly suited to describing the variety of dimensions that change as one travels from a remote forest outpost, through fields and pastures, past tiny hamlets then small towns with weekly farm markets, across intensively cultivated areas near larger towns and small cities, to eventually reach the center of a cosmopolitan megacity. The changes may sometimes be abrupt, but more often are gradual; agriculture declines as an area's income and employment source, and land uses tend to shift from forestry to pasture to crops to vegetables, becoming more intensive as larger cities are approached. The proportion of indigenous people may decrease, reflecting historical settlement or exclusion patterns. Access to infrastructure and social services and off-farm employment all rise with population density and incomes. Along this continuum from the most rural to the most urban, a settlement of 1,500 people—a typical official threshold of urbanity—is arguably closer to the rural pole than the urban, and probably embraces many settlements that are physically and economically embedded in an agricultural space.

For practical policy objectives and comparisons across countries it would be useful to specify precisely what aspects of rurality are of interest and to characterize criteria for identifying these aspects. Two aspects of rurality are fairly clearly important in the context of economic activity and the provision of social services: a geographic area's population density and its population's remoteness from large cities. These aspects are potentially measurable and constitute important gradients along which economic behavior and appropriate development interventions might vary substantially.

Low population densities mean that markets of all kinds are thin, and unit costs are high for the delivery of most social services and for many types of public and private investments. Along with transport, other infrastructure, and amenities, density drives the agglomeration economies that characterize cities, which in turn are due to fixed facility costs that drive average travel costs for reaching households. Economies of density are exemplified by the provision of elementary education, public health, agricultural extension, grid-linked electricity, and feeder roads. Moreover, low population density areas may be too small to support competition in some product and service markets, notably transportation, leading to local monopolies. Each of these considerations likely has a distinct relationship with density and with other factors, making it difficult to designate a unique urban-rural cutoff density. If it is necessary to adopt an arbitrary cutoff along this gradient, however, it may be useful to refer to the OECD threshold of 150 people/km^2.

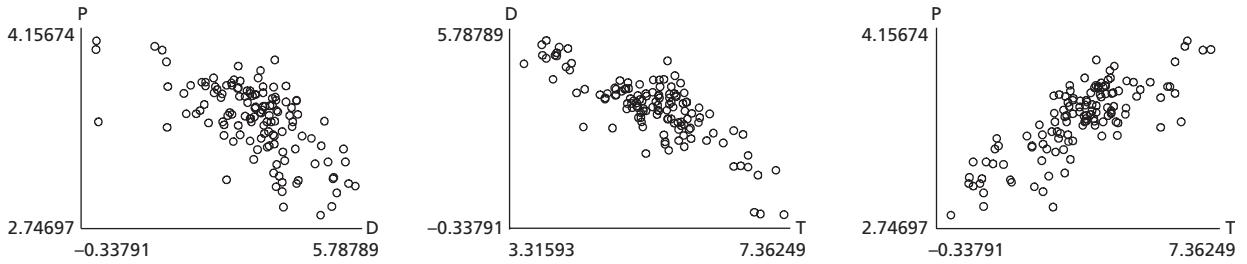
The greater an area's distance from large urban centers, the lower the prices of the products produced on the farm or in the factory, and the higher the prices of inputs brought into the area. It would be more difficult to recruit skilled personnel to public service or private enterprises.

For many purposes, areas within easy commuting radius of a major urban center can be considered urban, even if occupied by farmsteads. The edge of this commuting radius may constitute a meaningful breakpoint or discontinuity on the urban-rural divide, though it is not sharply delineated. As the travel radius expands slightly, farm and nonfarm households may still enjoy some urban employment opportunities and can profitably grow fruits and vegetables for urban markets. Perhaps one might locate here, at the von Thünen distance associated with truck farming for urban consumption, another meaningful breakpoint between urban and rural, though it is even less sharply defined. In theory, as the distance to markets increases still further, activities will systematically change; households either produce goods with low relative transport costs or shift toward subsistence production. There will also be a strong though not universal tendency for population density to decline as remoteness increases. In short, remoteness and low population densities together define a set of rural areas that face special development challenges.

How might one go about measuring the degrees of Latin American and Caribbean rurality based on population densities and remoteness criteria? CBT made use of the information provided by CIESIN 2004 (GPW v.3),[17] version 3 (GPW 3). GPW 3 assembled census population data at fine-level administrative units (municipalities, for the most part); assuming a homogeneous within-municipality distribution, population densities were imputed to 5-km-square grid cells. This allows population density data to be cross-tabulated against remoteness from the nearest city of over 100,000, based on a rough travel time assessment.[18] In addition, because remoteness and population density measures alone cannot capture completely the heterogeneity that exists in rural areas, population can also be cross-classified by physical geography indicators: both agro-climatic suitability for cropping and forest cover. These additional geographic characteristics work to

FIGURE 2.2

Relationships between remoteness, population density, and poverty in Nicaragua



Source: Kenneth Chomitz (World Bank).
Note: P = log percent extreme rural poverty rate; D = log rural population density 1995; T = log travel time to Managua.

shape opportunities and constraints for rural development and the linkages between the environment and development. The result of these cross-classifications is a flexible framework for assessing the concept of "rurality" along different dimensions, each of which constitutes a gradient. Nevertheless, arbitrary dividing lines, or thresholds, between rural and urban can be designated for analytical convenience.

The quantitative results presented here are conditioned on the reporting unit's size and heterogeneity. They are not wholly comparable across countries, although they may be more consistent than existing official estimates, based on a variety of country-specific criteria of what is urban and what is rural. Within municipalities, there is likely to be heterogeneity of population densities. Because these population densities are computed, for the most part, at the administrative unit levels, low-density areas are likely to contain market towns or even small cities, and the mean population densities estimate discussed above would not correspond exactly to the reality at submunicipal areas.[19]

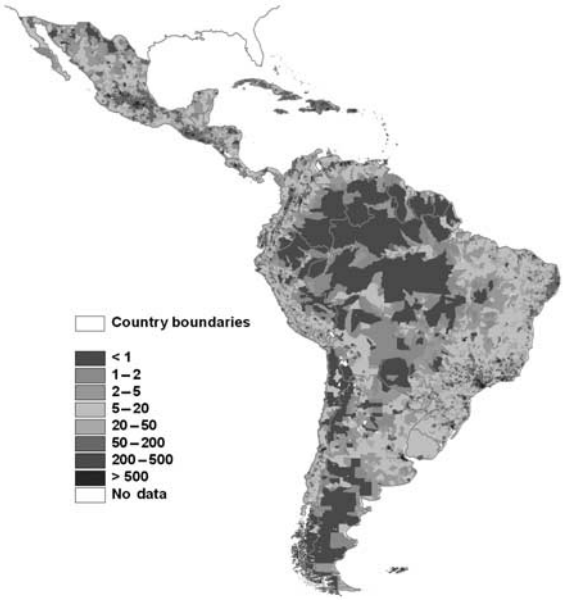
Figure 2.2 illustrates the rural-urban gradient in the context of Nicaragua, based on municipal-level data. The figure shows a strong correlation between travel time to Managua, incidence of severe rural poverty, and low population density (all measured in logs). The relation's tightness and smoothness is remarkable. However, the graphs exclude the Managua Department's six municipalities, which show a sharply lower poverty rate than would be predicted by travel time alone.

Toward the density and remoteness gradient's rural end, areas are by no means homogeneous. Agro-climatic suitability for cropping and current forest cover are important factors in determining the prospects for agriculturally-led rural development and development's potential effect on environmental externalities. Both factors are best viewed as continuous variables.

Figure 2.3 maps population densities from the GPW data. Keep in mind that, for the most part, these represent municipality-level averages.

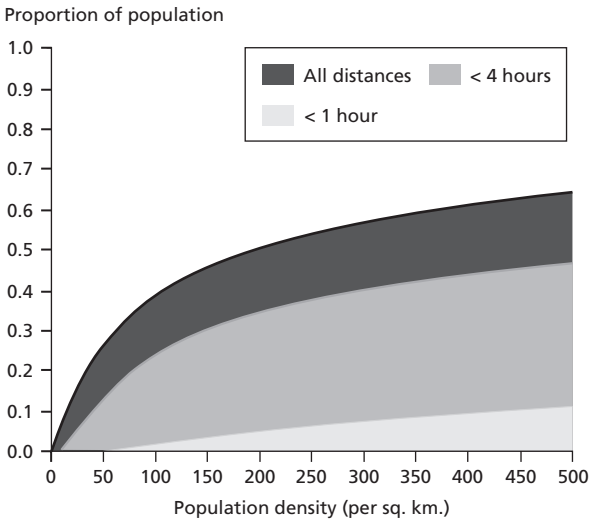
Table 2.14 tabulates population proportion density by population threshold for Latin America and the Caribbean as a whole and for selected countries, breaking out those areas more than one hour travel time from cities with more than 100,000 people (here designated as "remote"). In all cases, the proportions refer to the total national population, so for instance, we read that 46 percent of all Argentines live at population densities below 150, and 44 percent of all Argentines live in cells that both have densities below 150 and are more than one hour travel time from a city of 100,000. Figures 2.4 and 2.5 show these data graphically for the Latin America and the Caribbean region and Brazil in the form of the proportion of the national population living in areas of density less than or equal to the value (on the x-axis) of a specific population density per square kilome-

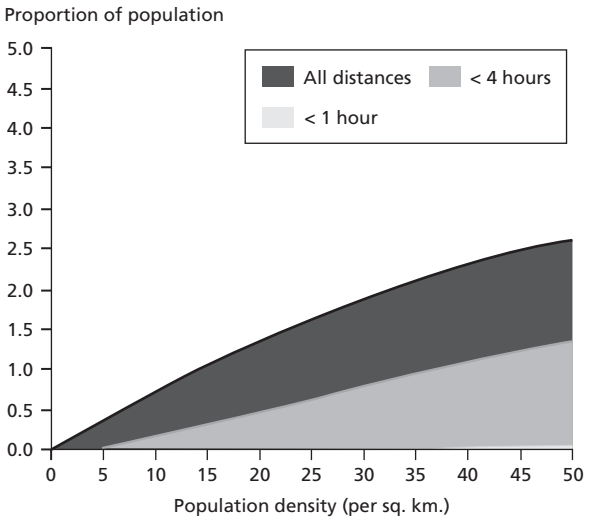
FIGURE 2.3
Population density in Latin America and the Caribbean



Source: CIESIN 2004 (GPW v.3).
Note: Number of people per square kilometer.

FIGURE 2.4
Cumulative population distribution in Latin America and the Caribbean relative to distance from a major city





Source: Population and density from CIESIN 2004 (GPW v.3)

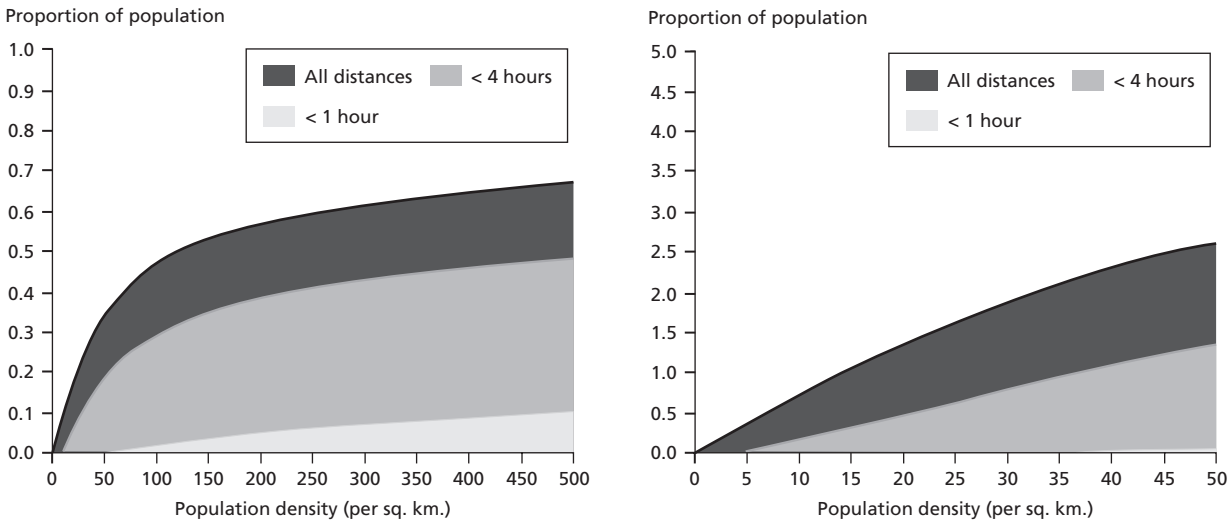
ter. Because one might be agnostic about density thresholds to define what is rural and what is not, each graph is presented both on a density scale of 0 to 50 people per square kilometer and on a density scale of 0 to 500 people per square kilometer.

According to the tabulations, about 13 percent of the Latin American and Caribbean populations live at extremely low densities of less than 20 per square kilometer. In effect, almost all of these people are more than one hour's drive from a large city, and more than half live more than four hours' away. This group plays a key role in determining effective environmental management because they occupy the great bulk of the continent's territory and forests. About one-quarter of Latin America and the Caribbean's population is estimated to live at densities below 50, again essentially all of them more than an hour from a large city and nearly half in very remote conditions (four or more hours' travel time to a city). While this group may include well-off households (prosperous farmers, for example) it certainly contains a large number of very poor people. Almost half (46 percent) of Latin America and the Caribbean live at population densities below 150; more than 90 percent of this group is at least an hour's time from a city, and about one-third of them (18 percent of the Latin American and Caribbean total) are more than four hours' travel time (see table 2.15). Even at densities of up to 500, the great majority of people are more than an hour from cities.

Figure 2.6 graphs the "remote" (greater than an hour of travel time) columns of table 2.15, with countries arranged in ascending order according to the density-150 threshold. It shows that density-100, density-150, and density-200

FIGURE 2.5

Cumulative population distribution in Brazil relative to distance from a major city



Source: Population and density from CIESIN 2004 (GPW v.3)

TABLE 2.15

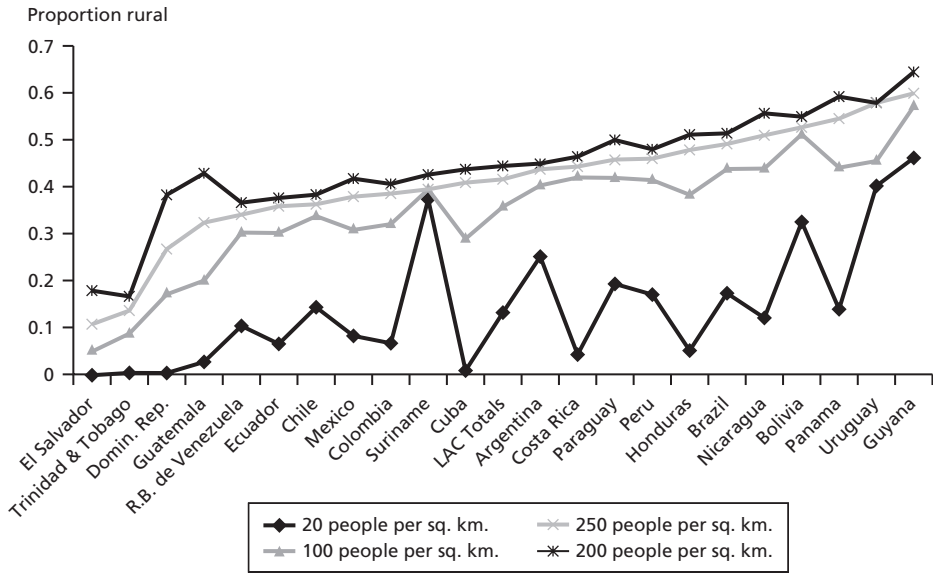
Rural population (absolute value) and rural as percentage of total

	Total rural population			Rural as % of total		
Country	1990 (millions)	2001 (millions)	Percentage change	1990	2001	Difference
Argentina	4.34	4.4	–0.4	13.5	11.7	–1.8
Bolivia	2.9	3.2	8.2	44.4	37.1	–7.3
Brazil	37.4	31.6	–15.5	25.2	18.3	–6.9
Chile	2.2	2.2	–1.9	16.7	14.0	–2.8
Colombia	10.9	10.6	–3.5	31.3	24.5	–6.8
Costa Rica	1.4	1.6	11	46.3	40.5	–5.8
Dominican Republic	3	2.9	–1.4	41.6	34.0	–7.5
Ecuador	4.6	4.7	2.2	44.9	36.6	–8.3
El Salvador	2.6	2.5	–4.7	50.8	38.7	–12.1
Guatemala	5.4	7	29.5	61.9	60.0	–1.9
Honduras	2.8	3.1	7.7	58.2	46.4	–11.8
Jamaica	1.2	1.1	–3.1	48.6	43.4	–5.1
Mexico	22.9	25.3	10.2	27.5	25.4	–2.1
Nicaragua	1.8	2.3	26.1	46.9	43.5	–3.5
Panama	1.1	1.3	13.4	46.3	43.4	–2.8
Paraguay	2.1	2.2	4.9	50.5	40.8	–9.7
Peru	6.7	7.1	5.6	31.1	26.9	–4.2
Uruguay	0.3	0.3	–22.6	11.0	7.9	–3.1
Venezuela, R.B. de	3.1	3.1	1.2	16.0	12.8	–3.2
Latin America and the Caribbean	*125.6*	*125.4*	*–0.2*	*28.9*	*24.2*	*–4.8*

Source: United Nations 2002.
Note: Rural population is calculated as the difference between the total population and the urban population. Urban population is the midyear population of areas defined as urban in each country and reported to the United Nations.

FIGURE 2.6

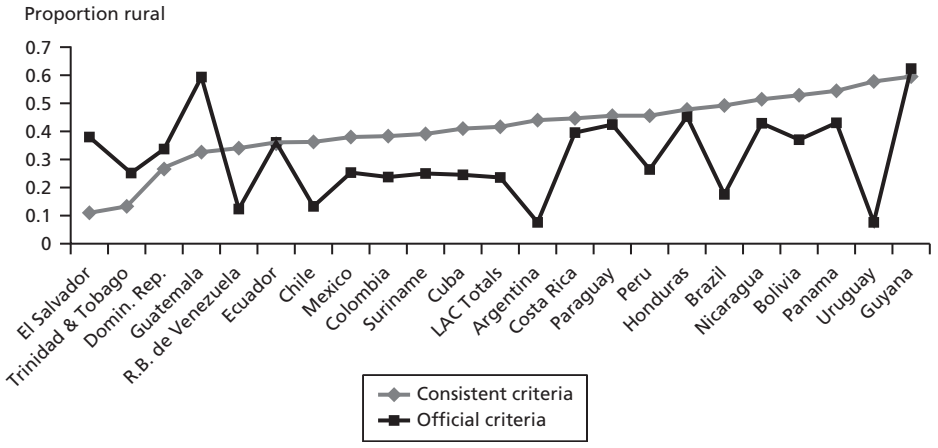
Proportion of population that have more than one hour travel time to a city of 100,000 people and that are below the specified population density thresholds



Source: CIESIN 2004 (GPW v.3).
Note: Lines refer to rural populations at four different population densities.

FIGURE 2.7

Census rurality measures compared to definition of <150 person per square kilometer and > 1 hour travel time criteria



Source: CIESIN 2004 (GPW v.3).
Note: Consistent criteria applies to all countries (OECD); official criteria varies by country. See text.

thresholds yield roughly the same ranking of countries and roughly similar estimates of rurality. The density-20 threshold, however, is poorly correlated with the others. For instance, Costa Rica, Cuba, and Peru have roughly similar rural proportions according to the density-150 threshold, but Peru has proportionately far more people living at densities below 20.

Figure 2.7 compares the rurality criterion density-150 (>1 hour travel) to census measures of rurality. There are some striking disparities. Census measures ascribe much

TABLE 2.16

Urban and rural populations defined, based on data provided

	Rural is determined by					
Country	Population size	Population density	Service provision	% of primary activity	Administrative division	House agglomeration
Argentina	X					
Bolivia	X					
Brazil					X	
Chile	X			X		
Colombia					X	
Costa Rica			X		X	
Cuba	X		X			
Dominican Republic					X	
Ecuador					X	
El Salvador					X	
Guatemala					X	
Haiti					X	
Honduras	X		X			
Mexico	X					
Nicaragua	X		X			
Panama	X		X			
Paraguay					X	
Peru						X
Uruguay			X		X	
Venezuela, R.B. de	X					
OECD		X				

Source: ECLAC; Martine Dirven kindly provided this information.

lower rural populations to Argentina, Brazil, and Uruguay, and much lower populations to El Salvador and Guatemala, compared with the measure based on density and distance.

Finally, tables 2.16 and 2.17 cross tabulate population and land area by population density, suitability for rainfed crops, and forest cover. About one-fifth of the Latin American and Caribbean population lives at densities below 150 on nonforested areas that are suitable for rainfed crops. They occupy 29 percent of the Latin American and Caribbean land area. Almost the same numbers of people live at densities under 150 and occupy land that is rated marginal or unsuitable for rainfed crops; these lands constitute 45 percent of Latin America and the Caribbean, including 16 percent that is both poor for crops and under forest cover. And about 6 percent of the total population lives at densities less than 150, occupying land that is suitable for crops, but currently largely forested. Constituting about 25 percent of Latin America and the Caribbean, these lands may present policy-relevant development-environment tradeoffs.

It is worth repeating that "rurality" is a multidimensional concept, and that there are many characteristics associated with the concept, such as access to social services and infrastructure, linkages to employment and commodity markets, and involvement with agriculture and natural resources. These characteristics are correlated, but not perfectly so, and the specific characteristics of interest depend on the particular policy question to be analyzed. But it is important to emphasize that the degree of rurality is a gradient rather than a dichotomy between mutually exclusive rural and urban abstractions. Although there does not appear to be a natural dividing line or breakpoint between rural areas and urban areas in many characteristics of interest, in policy formation, for example, one must often decide on some thresholds or categories to guide administration. In this context, population density and remoteness from large cities constitute two useful "general purpose" indicators of rurality, as both emphasize the continuous nature of the rural-urban gradient. Arguably, the development challenges at 1, 15, 150, and 1,500 persons per square kilometer are qualitatively quite distinct, even though communities at all but the highest of these densities would be officially treated similarly as "rural."

In the Latin American and Caribbean region, traditional census measures of rurality exclude small towns embedded in agricultural areas, tending to designate very small settle-

TABLE 2.17

Proportion of total population by population density and remoteness

	Population density per square kilometer (%)					
	< 20		< 50		< 100	
Country	All	Remote	All	Remote	All	Remote
Argentina	26	25	37	36	42	41
Bolivia	33	33	43	42	54	51
Brazil	18	17	34	33	47	44
Chile	15	14	27	25	39	34
Colombia	7	7	21	20	35	32
Costa Rica	4	4	23	23	44	43
Cuba	1	1	11	10	36	29
Ecuador	7	7	20	18	35	31
Guatemala	3	3	7	7	21	20
Guyana	46	46	58	56	59	58
Honduras	5	5	22	21	41	39
Mexico	8	8	19	18	34	31
Nicaragua	12	12	26	26	47	44
Panama	14	14	32	32	44	44
Paraguay	20	20	35	35	42	42
Peru	17	17	32	32	43	42
Uruguay	40	40	45	45	46	46
Venezuela, R.B. de	11	10	23	22	34	31
LAC totals	13	13	26	25	39	36

Source: Population and density are from CIESIN 2004 (GPW v.3).
Note: Totals include all Latin American and Caribbean (LAC) countries, including those that do not appear in the table. There were a small number of coastal gridcells that were missing country codes and were therefore omitted from the above table. The denominator for the percentage was total population as given by the tabulated cells and excluding those few cells with omitted country codes. "Remote" means that the gridcell is located an hour or more away from a city of 100,000 people.

TABLE 2.18

Proportion of total population, relative to hours of travel to a city of 100,000 people and low population density

	Hours to city of 100,000 people (%)					
	< 1		1–4		> 4	
Country	All	< 150 / sq. km.	All	< 150 / sq. km.	All	< 150 / sq. km.
Argentina	50	3	29	23	21	21
Bolivia	20	3	37	22	43	31
Brazil	42	4	40	31	18	18
Chile	40	7	51	28	9	8
Colombia	42	4	46	28	13	11
Costa Rica	49	2	30	23	21	21
Cuba	50	13	49	40	1	1
Ecuador	49	8	43	29	9	7
Guatemala	35	3	59	26	6	6
Guyana	5	2	26	8	69	52
Honduras	33	4	62	43	5	5
Mexico	47	5	42	28	10	10
Nicaragua	35	5	47	34	17	17
Paraguay	45	1	20	14	35	32
Peru	43	2	22	16	36	30
Panama	26	1	26	13	48	42
Uruguay	37	1	23	18	40	40
Venezuela, R.B. de	51	5	40	26	10	8
LAC totals	43	4	40	27	18	15

Source: Population and density data are from CIESIN 2004 (GPW v.3).
Notes: Totals include all Latin American and Caribbean (LAC) countries, including those that do not appear in the table. There were a small number of coastal gridcells that were missing country codes and were therefore omitted from the above table. The denominator for the percentage was total population as given by the tabulated cells, excluding those few cells with omitted country codes.

ments as urban, implicitly using access to basic services (health clinic, school, paved road) as the criterion for defining urbanity. It is on this basis that Latin America and the Caribbean is designated as a mostly-urbanized continent. In fact, a large proportion of the population lives in areas of ambiguous urbanity—small farm-oriented villages embedded in an agricultural countryside. From a policy perspective, perhaps the rural-urban dichotomy has been exaggerated, and inconsistent notions of what constitutes a dividing line between the two may be a hindrance rather than an aid to formulating regionally-articulated development policies.

Given the diversity of definitions of rural and urban populations in the Latin America and Caribbean region, it would be useful to promote a debate over what would constitute the most appropriate criteria for defining rurality. There are advantages in adopting a common set of criteria as is done for other fields in the Latin America and the Caribbean region, such as national accounts, balance of payments, uniformity in household survey analysis, and others. Of course, adopting a common definition of rurality, for example, based on the above density-distance gradient, would require a reformulation of a number of important statistics, such as rural poverty rates, income flows, infrastructure measures, and other pertinent data, which are unavailable at present. But the adoption of a common set of criteria for defining rurality will become increasing more relevant for the comparison of assistance to rural areas affected by changes in sectoral policies as part of regional integration schemes.

TABLE 2.19

Proportion of total population by land category and low population density

	Land category (%)							
	Suitable for rainfed crops, not forested		Unsuitable for rainfed crops, not forested		Suitable for rainfed crops, forested		Unsuitable for rainfed crops, forested	
Country	All	< 150/sq. km.	All	< 150/sq. km.	All	< 150/sq. km.	All	< 150/sq. km.
Argentina	76	28	21	16	2	2	1	1
Bolivia	28	10	50	31	16	11	5	3
Brazil	66	33	19	10	10	8	5	3
Chile	21	7	60	24	7	4	12	9
Colombia	20	10	55	18	7	6	18	9
Costa Rica	5	5	12	8	7	7	76	26
Cuba	82	41	3	2	8	7	8	5
Ecuador	60	22	35	18	2	2	3	2
Guatemala	7	5	50	10	7	5	36	15
Guyana	25	12	9	3	52	41	14	8
Honduras	19	8	28	16	11	6	42	23
Mexico	42	13	35	19	10	4	12	7
Nicaragua	42	19	29	19	9	6	20	12
Paraguay	68	22	3	2	25	19	4	3
Peru	8	6	80	33	7	5	5	4
Panama	31	16	19	10	13	6	38	23
Uruguay	98	58	2	2	0	0	0	0
Venezuela, R.B. de	48	19	17	6	22	10	13	4
LAC totals	48	20	32	14	10	6	11	5

Source: Population and density are from CIESIN/CIAT Gridded Population of the World 3; rainfed crop suitability data are from FAO/IIASA Global Agro-Ecological Zones.
Note: Totals include all Latin American and Caribbean (LAC) countries, including those that do not appear in the table; there were a small number of coastal gridcells that were missing country codes and were therefore omitted from the above table; the denominator for the percentage was total population as given by the tabulated cells, excluding those few cells with omitted country codes; "unsuitable" include GAEZ classifications as marginal, very marginal, and not suitable.

Summary of the Latin American and Caribbean rural sector's size

The RNR sector's significance varies across the Latin American and Caribbean countries, although in GDP terms, it is the lowest in the developing world. But the RNR sector's comparatively low and decreasing shares give a misimpression of the sector's larger importance in the national economy. The sector has important linkages to the rest of the economy that appear to be increasing; RNR exports have been more than one-third of export revenues in recent years. The contribution to export earnings, however, varies widely across countries. RNR export shares for Nicaragua and Ecuador are more than 30 percent, whereas the oil exporting countries of Mexico and República Bolivariana de Venezuela have very low shares. Even for countries where agriculture's GDP share is relatively low, RNR exports represent a higher share in total exports (for example, in Argentina, Brazil, Chile, and Mexico). Latin American and Caribbean countries' net trade positions (in food, agricultural products, forestry, and fisheries) also show a high degree of heterogeneity, but in terms of the *number* of countries, the region is surprisingly import-dependent with respect to food products, a point relevant to the debate on WTO trade liberalization.

With respect to who and what is rural, the official rural statistics are based on heterogeneous criteria and undercount the population living in remote and low-density areas. There is no clear international standard for defining rurality, and rurality should be considered as a gradient, not a discrete condition. Official measures often overlook rural villages embedded in agricultural areas, and official definitions tend to designate even very small settlements as urban. More people live in low-density, remote areas in the region than one would be led to believe from official statistics. Based on official definitions of rural populations, the

TABLE 2.20

Proportion of total land area by land category and low population density

	Land category (%)							
	Suitable for rainfed crops, not forested		Unsuitable for rainfed crops, not forested		Suitable for rainfed crops, forested		Unsuitable for rainfed crops, forested	
Country	All	< 150/sq. km.	All	< 150/sq. km.	All	< 150/sq. km.	All	< 150/sq. km.
Argentina	37	36	60	60	1	1	2	2
Bolivia	31	30	28	28	37	37	4	4
Brazil	35	34	15	15	35	35	15	15
Chile	5	5	68	67	4	4	23	23
Colombia	21	20	20	19	28	28	31	30
Costa Rica	10	10	18	18	17	17	54	48
Cuba	75	66	3	2	14	13	9	8
Ecuador	28	25	37	35	14	14	21	21
Guatemala	10	9	24	15	31	31	34	26
Guyana	10	10	2	2	63	63	25	25
Honduras	12	12	25	24	17	16	45	44
Mexico	18	16	58	56	9	9	15	15
Nicaragua	23	21	16	15	32	32	28	28
Paraguay	54	53	25	25	18	17	4	4
Peru	5	5	41	40	23	23	31	31
Panama	21	19	18	17	18	17	44	42
Uruguay	97	97	3	3	0	0	0	0
Venezuela, R.B. de	37	35	7	6	28	28	28	28
LAC totals	30	29	29	29	25	25	16	16

Source: Population density is from CIESIN/CIAT Gridded Population of the World 3; rainfed crop suitability data are from FAO/IIASA Global Agro-Ecological Zones.
Note: Totals include all Latin American and Caribbean (LAC) countries, including those that do not appear in the table; there were a small number of coastal gridcells that were missing country codes and were therefore omitted from the above table; the denominator for the percentage was total area as given by the tabulated cells, excluding those few cells with omitted country codes; "unsuitable" includes GAEZ classifications of marginal, very marginal, and not suitable.

region's rural non-agricultural employment sector is large and would be even larger if low-density and remoteness criteria (such as that of the OECD) were applied. Rural nonfarm employment represents an increasingly important part of the rural economy in terms of income, employment, poverty alleviation, and rural economic development. Understanding the rural economy is especially important because the rural poverty incidence is very high and is higher than in urban areas. For example, there are six countries in the region where at least 70 percent or more of the rural population lives in poverty, and another seven where more than one-third live in poverty.

Notes

1. Minerals, petroleum, and gas are excluded from the RNR coverage in this report.

2. Studies on linkages focused on Asia, with some treatment of Sub-Saharan Africa, but little if any on Latin America.

3. What is called the agricultural GDP depends on country-specific definitions. For example, in Chile agriculture includes all crops, livestock, forestry, and agricultural services such as farm machinery rentals, farm labor subcontracting, irrigation well drilling, and other sector-specific services. Sectoral GDP estimates vary by definition of included activities. They also differ by year and by the I-O matrix upon which yearly estimates are based.

4. Each I-O matrix disaggregates each sector's output into intermediate consumption (goods and services used as inputs by the same and other sectors), final demand—composed of the consumption of households, government, or foreign consumers (exports)—and a portion used as investment.

5. For Colombia, the I-O matrix is derived from a year 2000 SAM (social accounting matrix) that Planeación Nacional in Bogota supplied, and linkages are based on 2000 GDP estimates. For Mexico, the I-O matrix dates to 1980, and linkages are calculated based on 2002 GDP estimates. For Chile, I-O matrices for 1986 and 1996 are available, and linkages are calculated for sectoral GDP estimates for 1996 and 2001 (using the 1996 I-O coefficients).

6. In the development policy modeling literature, studies based on the same I-O coefficients examined above have taken a Hirschman-

style, economic-impact multiplier approach to answering questions regarding the final impacts of particular shocks and policy changes to the RNR sector. These studies go beyond industry linkages and seek to include household income effects from social accounting matrices in simulations. Much of this multiplier work has been motivated by "choice of strategic sectors": In which sectors should investment be targeted to yield the greatest impacts either in terms of growth or household incomes or poverty reduction? These impacts would derive from "linkage effects" through both production and consumption, describing how a shock is absorbed throughout the economy. In Latin America, unlike South Asia, for example, we would expect to find lower consumption-side multipliers and higher production multipliers. Lower consumption multipliers result because agriculture has a far smaller national GDP share; higher production multipliers result because agriculture is demanding a higher share of intermediate inputs from the rest of the economy and a higher participation as an intermediate input in other sectors, such as processed foods. In many studies for poorer countries the consumption-side effects have been found to be large relative to production effects, due to the relatively higher share of income generated by agriculture and the isolation of agriculture from other sectors. (In Africa, consumption linkages account for 75 to 90 percent of the total multiplier; and in Asia, for 50 to 60 percent (Sadoulet and de Janvry, 295 [1995]).

7. The reader should remember that the latest I-O matrix for Mexico dates back to the pre-NAFTA 1980 period.

8. Two countries, Bolivia and Guatemala, are borderline cases of net food importation. Particularly in the Santa Cruz area, Bolivia produces soybeans, rice, and other grains.

9. See, for example, López and Valdés (2000) for analyses on Chile, Colombia, El Salvador, Honduras, Paraguay, and Peru. There are also various World Bank studies that Quentin Wodon directed and several recent poverty assessments, such as for Guatemala, Nicaragua, and other countries.

10. The data available divide agricultural employment into two groups: salaried employees, and the self-employed and unremunerated family members. Rural nonfarm employment refers to workers and others making a living outside of production agriculture, such as in manufacturing or services. While the data do differentiate between the self-employed in agricultural production and those in nonfarm activities, for salaried workers there is no distinction made between farm and nonfarm work.

11. Lanjouw (2000, 118) also notes, "Clearly a minimum prerequisite and one that in the past has often been lacking in rural parts of Latin America is a measure of safety and personal security."

12. World Bank's 2002 rural strategy presents a discussion of the recommendations for supporting the rural nonfarm economy. See World Bank 2002b.

13. The importance of a good investment climate for small entrepreneurs in the development of rural areas was well documented in the case of India in Stern (2001). Bureaucracy, corruption, and poor infrastructure take their largest tolls on small-scale firms in rural areas.

14. No international standard exists in defining an urban-rural dichotomy. In fact, the United Nations argues that "given the variety of situations in the countries of the world, it is not possible or desirable to adopt uniform criteria to distinguish urban areas from rural areas" (United Nations 2002, 106). Accordingly, the official United Nations urban and rural population statistics are based on inconsistent national standards.

15. For a summary of the definitions of urban and rural populations used in Latin America and the Caribbean over the last several decades, see CEPAL, 1999, "Latin America: Projections of Urban and Rural Populations, 1970-2025," Boletín Demográfico 63, January, http://www.eclac.cl/Celade/publica/bol63/BD63def00e.html.

16. Peru assesses settlement size in terms of houses rather than people.

17. Center for International Earth Science Network (CIESIN), Columbia University; and Centro Internacional de Agricultura Tropical (CIAT), 2004. Gridded Population of the World, version 3, Palisades, NY: CIESIN, Columbia University. Documentation is available at http://beta.sedac.ciesin.columbia.edu/gpw. We are grateful to CIESIN for making this data available.

18. Andrew Nelson computed the accessibility map, based on road data from the Digital Chart of the World; travel speeds were assumed by road category. Because of input data limitations, the travel time classification should be considered as a crude index.

19. A new version of the Gridded Population of the World (GRUMP v.1) will be available soon and should provide improved estimates of density distributions.

20. To the extent that fixed proportions might characterize activities, non-agricultural activities would not exist without farm products, giving some credence to the attribution of all of an agriculture-dependent downstream sector's GDP to agriculture generally. The possibility of importing such farm products would severely lessen the validity of such an attribution to domestic agriculture.

21. Dirven's multipliers exclude linkages with transport, commerce, financial services, and public services, which are included in our estimates.

Annex A

TABLE A2.1

Share of RNR products in total exports, 1980–2001 (percent)

Country	1980	1985	1990	1995	1999–2001
Argentina	53.7	55.7	47.5	42.6	37.7
Bolivia	11.5	4.6	23.9	26.5	27.8
Brazil	47.2	37.5	29.5	31.8	27.5
Chile	19.7	29.8	28.1	31.4	28.6
Colombia	58.1	51.4	29.0	29.8	21.4
Costa Rica	57.8	57.1	47.3	41.8	24.3
Dominican Republic	42.2	37.3	20.9	7.0	6.4
Ecuador	29.5	25.5	39.3	46.6	39.8
Guatemala	61.5	71.5	52.9	47.6	39.8
Haiti	36.9	20.1	10.2	19.3	—
Honduras	71.9	69.7	68.2	37.3	28.5
Jamaica	9.7	11.9	10.3	9.1	8.1
Mexico	10.7	6.9	7.1	7.5	5.0
Nicaragua	75.9	87.2	65.0	60.7	51.0
Panama	8.7	9.9	8.7	5.9	6.8
Paraguay	52.6	64.3	33.2	16.4	25.3
Peru	14.0	14.0	16.5	21.4	21.5
El Salvador	70.1	61.3	35.8	27.9	16.1
Trinidad and Tobago	2.7	1.9	5.0	7.2	5.5
Uruguay	37.3	36.3	40.6	30.0	33.3
Venezuela, R.B. de	0.4	1.6	2.2	2.9	1.9

Source: Agriculture, forestry, and fisheries exports are from FAOSTAT; all exports from WDI (exports of goods and services, balance of payments) in current dollars.
Note: — Not available.

TABLE A2.2

Classification of countries according to per capita income and development level, 1999–2001

Country	GDP per capita ($)	WB classification	UN classification	LIFDC
South America				
Argentina	7,535	UMIC	DC	n.a.
Bolivia	986	LMIC	DC	n.a.
Brazil	3,228	UMIC	DC	n.a.
Chile	4,714	UMIC	DC	n.a.
Colombia	1,975	LMIC	DC	n.a.
Ecuador	1,632	LMIC	DC	LIFDC
Paraguay	1,413	LMIC	DC	n.a.
Peru	2,046	LMIC	DC	n.a.
Uruguay	5,951	UMIC	DC	n.a.
Venezuela, R.B. de	4,833	UMIC	DC	n.a.
Central America				
Costa Rica	4,217	UMIC	DC	n.a.
El Salvador	2,088	LMIC	DC	n.a.
Guatemala	1,709	LMIC	DC	n.a.
Honduras	922	LMIC	DC	LIFDC
Mexico	5,727	UMIC	DC	n.a.
Nicaragua*	—	LIC	DC	LIFDC
Panama	4,133	UMIC	DC	n.a.
Caribbean				
Cuba*	—	—	DC	LIFDC
Dominican Republic	2,312	LMIC	DC	n.a.
Haiti	496	LIC	LDC	LIFDC
Jamaica	2,983	LMIC	DC	n.a.
Trinidad and Tobago	6,151	UMIC	DC	n.a.

Source: World Bank 2003a.
Note: GDP per capita is the average in dollars for 1999–2001. LMIC: lower middle income country; UMIC: upper middle income country; DC: developing country; LDC: least developed country; LIFDC: low income, food-dependent country. * values unavailable; n.a. not applicable; — Not available; n.a. not applicable.

Annex B

TABLE B2.1

Trade balance of forestry products, 1990–92 and 2000–02 averages ($ millions)[a]

	1990–92				2000–02			
			Balance				Balance	
Countries	Exports	Imports	EX-IM	EX/IM	Exports	Imports	EX-IM	EX/IM
South America								
Argentina	142.6	180.3	–37.7	0.8	283.6	574.6	–291.1	0.5
Bolivia	43.6	8.4	35.2	5.2	25.7	41.6	–15.9	0.6
Brazil	1,616.2	282.9	1,333.3	5.7	2,911.7	871.9	2,039.8	3.3
Chile	880.8	98.9	781.9	8.9	1,791.6	235.6	1,555.9	7.6
Colombia	26.0	197.0	–171.0	0.1	105.4	363.2	–257.8	0.3
Ecuador	24.7	159.2	–134.5	0.2	58.7	117.4	–58.7	0.5
Paraguay	34.3	20.3	14.0	1.7	41.2	41.5	–0.3	1.0
Peru	5.2	104.0	–98.8	0.1	92.7	209.4	–116.7	0.4
Uruguay	21.4	35.8	–14.4	0.6	97.9	87.5	10.5	1.1
Venezuela, R.B. de	22.4	298.2	–275.8	0.1	54.2	315.2	–261.0	0.2
Total	2,824.5	1,392.3	1,432.2	2.0	5,502.6	2,866.7	2,635.9	1.9
Central America and Mexico								
Costa Rica	12.0	108.9	–96.9	0.1	22.8	258.7	–235.9	0.1
El Salvador	3.6	42.4	–38.8	0.1	10.9	159.2	–148.3	0.1
Guatemala	17.1	70.3	–53.1	0.2	24.6	181.3	–156.7	0.1
Honduras	21.0	59.0	–38.0	0.4	46.8	70.7	–23.8	0.7
Mexico	169.5	855.0	–685.5	0.2	228.4	2,458.5	–2,230.1	0.1
Nicaragua	2.5	8.6	–6.1	0.3	18.3	21.4	–3.1	0.9
Panama	3.9	69.4	–65.6	0.1	9.4	70.0	–60.6	0.1
Total	231.9	1,217.4	–985.4	0.2	365.3	3,227.0	–2,861.7	0.1
Caribbean								
Cuba	2.3	128.3	–125.9	0.0	0.3	57.6	–57.3	0.0
Dominican Republic	0.4	78.8	–78.4	0.0	0.6	204.1	–203.5	0.0
Haiti	0.0	7.4	–7.4	0.0	0.0	13.5	–13.5	0.0
Jamaica	1.2	63.6	–62.4	0.0	0.0	99.6	–99.6	0.0
Trinidad and Tobago	1.3	50.9	–49.6	0.0	2.3	98.0	–95.7	0.0
Total	5.9	486.0	–480.0	0.0	8.3	667.7	–659.4	0.0
Latin America and the Caribbean	3,062.3	3,095.6	–33.3	1.0	5,876.2	6,761.4	–885.2	0.9

Source: Authors' calculations from FAOSTAT.
a. Data are in millions of dollars deflated by the World Bank's manufacture index (1990 = 100). Forestry products include sawn wood, wood for pulping and particulate manufacture, paper and cartons, wood pulp, particulate board and pressed fiber, insulation, and other semi-processed products.

TABLE B2.2

Trade balance of fishery products, 1990–92 and 2000–01 averages ($ millions)

	1990–92				2000–01			
			Balance				Balance	
Country	Exports	Imports	EX-IM	EX/IM	Exports	Imports	EX-IM	EX/IM
South America								
Argentina	427.6	23.3	404.2	18.3	889.9	84.1	805.8	10.6
Bolivia	0.3	0.5	–0.2	0.6	0.0	7.7	–7.6	0.0
Brazil	152.9	169.9	–17.0	0.9	276.3	309.8	–33.4	0.9
Chile	1,031.6	16.8	1,014.7	61.3	1,947.5	60.2	1,887.3	32.3
Colombia	135.5	48.4	87.1	2.8	190.5	78.2	112.3	2.4
Ecuador	540.7	3.9	536.8	139.7	655.5	8.5	646.9	76.8
Paraguay	0.0	0.7	–0.7	0.1	0.1	1.7	–1.7	0.0
Peru	458.9	1.5	457.4	296.4	1,179.1	20.2	1,158.9	58.3
Uruguay	92.2	4.1	88.1	22.4	109.7	15.4	94.3	7.1
Venezuela, R.B. de	84.2	4.8	79.4	17.6	151.8	63.7	88.1	2.4
Total	2,991.1	279.2	2,711.9	10.7	5,523.4	654.7	4,868.7	8.4
Central America and Mexico								
Costa Rica	64.3	13.8	50.5	4.7	155.4	26.5	128.9	5.9
El Salvador	16.0	3.0	13.0	5.3	28.6	9.7	18.9	2.9
Guatemala	17.7	4.1	13.6	4.3	24.9	10.2	14.7	2.4
Honduras	43.2	2.0	41.2	21.4	72.8	15.3	57.5	4.7
Mexico	351.4	61.7	289.7	5.7	720.5	167.0	553.6	4.3
Nicaragua	16.9	1.5	15.4	11.1	88.3	6.9	81.4	12.7
Panama	72.6	10.7	61.9	6.8	231.2	12.0	219.2	19.3
Total	591.1	97.6	493.5	6.1	1,354.1	251.5	1,102.6	5.4
Caribbean								
Cuba	110.9	20.9	90.0	5.3	87.3	42.9	44.3	2.0
Dominican Republic	0.5	22.6	–22.1	0.0	1.2	57.5	–56.4	0.0
Haiti	1.9	4.3	–2.4	0.4	4.1	6.8	–2.7	0.6
Jamaica	6.3	26.9	–20.6	0.2	9.1	41.3	–32.2	0.2
Trinidad and Tobago	2.9	4.4	–1.5	0.7	11.0	8.3	2.7	1.3
Total	200.4	167.4	33.0	1.2	221.4	222.0	–0.7	1.0
Latin America and the Caribbean	3,782.6	544.2	3,238.4	7.0	7,098.8	1,128.2	5,970.6	6.3

Source: Authors' calculations from FAOSTAT.
Note: Data in millions of dollars deflated by the World Bank's manufactures index (1990=100). Fishery products include primary and processed (filets, frozen, and other preshipment processing).

Annex C

Computing agricultural sectoral linkages

An I-O matrix provides information to determine the size and extent of agriculture's forward and backward linkages. To measure these linkages we use the value of the intermediate transactions between sectors and each sector's value added. We use a weighting scheme that accounts for the domestic agriculture's participation level in the supply and demand of the production value of other sectors. This differs from other definitions of sectoral participation in the national economy that attribute all GDP in related industries to agriculture. A simple sum of sectoral GDPs would overstate national agriculture's role because any industry's GDP could be attributable to contributions from various sectors; other activities could claim the same links as agriculture.[20] For example, in the case of Chile, Dirven estimates that simply by adding related sector's GDPs to that of the crop-livestock-forestry sector, current agricultural GDP would rise from 4.4 percent of the national total to 15.1 percent.[21]

To assess forward linkages to other sectors' GDPs (agriculture's contribution to downstream activities) consider the following formula:

$$\text{C.1} \quad \left(\frac{X^T_{Aj}}{\sum_k X^T_{kj}}\right)\cdot\left(\frac{X^N_{Aj}}{X^T_{Aj}}\right)\cdot VA_j$$

where X^T_{Aj} represents the intermediate demand value for the agricultural sector's products as inputs used in sector *j*. The term X^T_{kj} represents the intermediate demand value for the products of the k^{th} sector used in sector *j*. The superscript *T* indicates the total amount of an input from all sources, national and imported, and *N* indicates national inputs. The term VA_j represents the standard value-added measure ascribed to the j^{th} sector. Equation (1) measures agriculture's forward linkage value as a proportion of the j^{th} sector's value added, equivalent to the ratio of agricultural inputs derived from the domestic sector to the total inputs used in another sector.

In a similar manner, to value the backward linkages consider the formula:

$$\text{C.2} \quad \left(\frac{X^T_{jA}}{\sum_k X^T_{jk}}\right)\cdot\left(\frac{X^N_{jA}}{X^T_{jA}}\right)\cdot\left(\frac{\sum_k X^N_{jk}}{TVO^N_j}\right)\cdot VA_j$$

where X^T_{jA} represents the product value of the j^{th} sector's output that agriculture used and X^N_{jA} represents the value that domestic agriculture used. The term TVO^N_j represents the j^{th} sector's total value of national output. The backward linkage portion of value added of sector *j* is the product of two elements: the share of national intermediate demand going to the agriculture sector relative to the total intermediate demand for sector *j*'s output (the first two terms of equation 2), and the share of the intermediate demand spent on sector *j* relative to the total value of output of sector *j* (the third term of equation 2). This backward linkage measure accounts for both the importance of the agriculture sector demand relative to the overall intermediate demand spent on the sector, as well as the intermediate demand's importance in the total value of the sector's output. Note that if a sector's output is destined for final consumption, the ratio in the third term in the above equation will be low.

CHAPTER 3

From Accounting to Economics: The Rural Natural Resource Sector's Contribution to Development

"Had human institutions . . . never disturbed the natural course . . . the progressive wealth would, in every political society, be consequential, and in proportion to the improvement and cultivation of the territory . . ."

Adam Smith, *The Wealth of Nations,* Book Two

THE PREVIOUS CHAPTER EXAMINED HOW THE RNR SECTOR'S SIZE VARIES WITH ALTERNATIVE sector definitions. When production of the commodity RNR sector that is used as inputs by other industries in the cases of Chile, Colombia, and Mexico is taken into account, the RNR sector's share of national GDP is substantially higher, but still quite small relative to national GDP. If the value of total production by the food processing industries, including food, beverages, and tobacco, is added to the size of the commodity RNR sector, the resulting average GDP share for Latin America and the Caribbean countries during 1960–2000 rises from 15 percent to over 21 percent (Bravo-Ortega and Lederman 2005, appendix). Alternative IICA estimates (2004) raise these GDP shares in a few Latin American and Caribbean countries to a bit over 30 percent by 1997. Even these numbers are small.

These GDP accounting exercises might be misleading when policy makers are interested in comparing the RNR sector's contribution to national welfare with that of the non-agricultural sector. The main reason why this is true is that an economic sector can be small relative to the size of the national economy, while at the same time it can have large impacts on the rest of the economy, which are not immediately apparent. The nature of these potential "spillover" or "multiplier" effects can be varied and are discussed in this chapter.

This chapter focuses on the RNR sector's contribution to national development. We look not only at the effect that agricultural production can have on the overall size of the national economy, but also at the RNR sector's contribution to the incomes of the poorest households, environmental outcomes, and the volatility of national GDP growth rates. That is, our definition of national development or welfare goes well beyond traditional considerations of GDP or national income. The main finding is that during the past 40 years or so, RNR growth has been associated with positive effects on Latin America and Caribbean welfare, which are roughly twice as large as agriculture's GDP share. However, this chapter pays close attention to international heterogeneity in the effects of this sector on the various components of national welfare, thus providing a rich set of results that vary not only across regions (that is, Latin America and the Caribbean is different from the rest of the world), but also across Latin America and Caribbean countries.

One of the key findings is that a one-percent growth in RNR GDP was associated with about a 0.12 percent growth in other industries. Although we did not identify the precise channels through which RNR growth leads to national GDP growth in excess of agriculture's GDP share, there is an extensive literature that provides numerous explanations of this phenomenon. This result is important for it implies that the long-term relative decline of the Latin American and Caribbean agricultural sector's size is a sign of strength; it is due to the positive effects that agricultural growth has on the rest of the economy. Thus as RNR productivity rises, the rest of the economy grows in the average Latin America and the Caribbean country. We did not find significant positive feedback effects going from other activities to RNR in Latin America and the Caribbean. Likewise, this chapter discusses evidence showing that the poverty-reducing effect of agriculture is smaller in absolute terms than the effect of the rest of the economy on the incomes of the poorest Latin American and Caribbean households. But the RNR sector's effect on the income of the poor is more than two times larger than what would be expected from its relative GDP.

Regarding environmental outcomes, the data suggest that RNR sector growth in Latin America and the Caribbean has been associated with the use of scarce freshwater resources, while other industries tend to pollute the air. The findings with respect to deforestation are a bit provocative: we find that, on average, RNR GDP growth in Latin American and Caribbean countries has not been associated with significant deforestation in the 1990s. But the descriptive evidence is quite clear in showing that in a few Latin American and Caribbean countries, such as Brazil, the expansion of the agricultural frontier was associated with major reductions in forestlands. Moreover, deforestation costs, even if small, can be quite large for Latin American and Caribbean countries and indeed for the world community, because deforestation is usually associated with threats to biodiversity that are difficult to quantify. Finally, this chapter also presents new estimates of the contribution of the RNR sector and non-RNR activities to macroeconomic volatility. Growth in both sectors is associated, as expected, with declines in volatility, but the reduction of volatility caused by RNR growth is relatively larger than that derived from the growth of other economic activities.

As mentioned, we find strong evidence suggesting that not all Latin American and Caribbean countries have the same sectoral contributions to the proposed components of national welfare. Thus the analyses of international experiences are complemented, when appropriate, with detailed case studies.

The rest of this chapter is organized as follows: Section 3.1 presents the analytical framework for studying the sectoral sources of national welfare, which is composed of income per capita, poverty, environment, and volatility; section 3.2 examines the relationship between the RNR sector's share in national GDP and the economic development process; section 3.3 turns to the effects of RNR and non-RNR labor productivity on incomes of poor households; section 3.4 studies the relationship between GDP composition and environmental outcomes; and section 3.5 explores the sectoral sources of macroeconomic volatility, paying close attention to the RNR sector's role in shaping the Latin American and Caribbean region's notorious economic uncertainty (De Ferranti, Perry, and Servén 2000). Section 3.6 presents our estimates of the welfare contributions of RNR and non-RNR economic activities in Latin America and the Caribbean and other regions of the world, which are based on the analytical and empirical findings of the previous sections.

3.1 RNR activities and welfare: Analytical framework

The first necessary step in this analysis is to define a national welfare function that links national welfare to national income per capita, incomes of the poorest households, environmental quality, and macroeconomic volatility. Deriving this welfare function is cumbersome, and the corresponding mathematical procedures are presented in box 3.1.

In a nutshell, the resulting national welfare function is the sum of the RNR sector growth's impacts on the four elements of national welfare, weighted by the sector's size and current environmental outcomes, and, in turn, weighted by subjective perceptions about the relative importance of each of the four elements that shape national welfare (development, poverty, environment, and volatility). To complicate matters even more, the empirical exercises discussed in this chapter were undertaken with sufficient rigor to deal with difficult issues of endogeneity and international differences in the behavior of key variables. Therefore, we took a cautious approach and calculated a set of national welfare effects derived from the growth rates of RNR and non-RNR activities in Latin American and Caribbean countries, other developing countries, and in high-income countries with various statistical techniques. In addition, the following sections also pay close attention to differences that might exist across the various Latin American and Caribbean countries.

BOX 3.1

Beyond GDP: Accounting for the effect of RNR activities on national welfare

National welfare can be expressed as a utility function, which rises with GDP per capita (y), increases with the average income of the poorest quintile ($y1$), increases with an indicator of environmental quality (E), and increases with the inverse of a measure of unexpected shocks or volatility (v):

(1) Welfare = $U(y, y1, E, 1/v)$.

For convenience, the functional form of the overall welfare function can be thought to be exponential, so that

$$U = y^{\alpha}(y1)^{\beta}E^{(\gamma)}\left(\frac{1}{v}\right)^{(1-\alpha-\beta-\gamma)}.$$

α, β, γ parameters are unknown weights of each element in the overall national welfare function. In section 3.6 we use alternative weights to compare the marginal welfare effects of RNR (A) and non-RNR production (N) across regions. The *elasticity* of national welfare with respect to A is given by the sum of the marginal effects of A on U through each element of the welfare function.

$$(2)\quad \frac{dU}{dA}\frac{A}{U} = \alpha\frac{\partial y}{\partial A}\frac{A}{y} + \beta\frac{\partial y1}{\partial A}\frac{A}{y1} + \gamma\frac{\partial E}{\partial A}\frac{A}{E} - \left(1-\alpha-\beta-\gamma\right)\frac{\partial v}{\partial A}\frac{A}{v}.$$

To calculate the welfare elasticity with respect to A, we need to examine its marginal contribution to each of the four elements in (2). First, y is the ratio of output over population Q/G. In turn, Q is composed of RNR (A) and non-RNR output (N), $Q = A + N$. Since $y = \frac{Q}{G} = \frac{A+N}{G_u + G_r}$, then $\frac{\partial y}{\partial A} = \left(\left(1+\frac{\partial N}{\partial A}\right) - \frac{\partial G}{\partial A}y\right)\frac{1}{G}$, where $\frac{\partial N}{\partial A}$ represents externalities plus multiplier effects of RNR on non-RNR GDP. By letting population changes be exogenous to agricultural output, the marginal effect of A on y boils down to the its impact on N: $\frac{\partial y}{\partial A} = \left(1+\frac{\partial N}{\partial A}\right)\frac{1}{G}$.

Regarding the second element in (2), the average income of the poor $y1$ is a weighted average of rural and urban incomes of the poor, both of which are functions of agricultural income and other determinants. Consider that the bottom quintile is defined as $y1 = \frac{Q_1}{G_1}$, with Q_1 the total income and G_1 the population of the bottom quintile. This chapter provided econometric estimates of

$$e_{y_1,(A/L_A)} = \frac{dy1}{d(A/L_A)}\frac{A/L_A}{y1} \text{ and}$$

$$e_{y_1,(N/L_N)} = \frac{dy1}{d(N/L_N)}\frac{N/L_N}{y1}.$$

These are elasticities of income per capita of the bottom quintile with respect to output per worker in A and N respectively. The income of the poorest quintile of the population is also a function of the labor and the value of production in A and N: $y1 = f(A, N, L_A, L_N)$. Thus

$$e_{y_1,(A/L)} = \frac{\partial y1}{\partial(A/L)}\frac{(A/L)}{y1} = \frac{\partial y_1}{\partial A}\frac{L}{L}\frac{A}{y1} = e_{y_1,A},$$

and there is an analogous result for $e_{y1,(N/L)}$. The derivative of $y1$ with respect to A/L_A can therefore be expressed as a function of the marginal effect of A on $y1$ plus an indirect effect via A's impact on N:

$$\frac{dy_1}{d(A/L_A)} = f(A,N,L_A) = \frac{\partial y_1}{\partial A}L_A + \frac{\partial y_1}{\partial N}\frac{\partial N}{\partial A}L_A = e_{y_1,(A/L_A)}\frac{y_1}{A/L_A} + e_{y_1,(N/L_N)}\cdot e_{N,A}\cdot\frac{y_1}{A/L_A},$$

where $e_{x,y}$'s are cross-sector elasticities.

Regarding the third element in the welfare function (2), environmental quality is defined as a land-weighted average of rural and urban environmental qualities, although alternative weights can be used. Define an index of environmental quality as follows:

$E = E_1^{\gamma_1}E_2^{\gamma_2}E_3^{1-\gamma_1-\gamma_2}$,

where E_1, E_2, E_3 represent three environmental outcomes. In particular E_1 and E_2 are measured with respect to a reference level of pollution per capita. That is, E_1, E_2, E_3 are defined as

$$E_1 = \left(M_1 - \frac{E_1'}{G}\right),\ E_2 = \left(M_2 - \frac{E_2'}{G}\right),\ E_3 = \left(\frac{1}{E_3'}\right).$$

BOX 3.1 **(Continued)**

This is necessary so that E_1, E_2 and E_3 correspond to measures of pollution that are strictly positive, which is a mathematical necessity in order to calculate an overall index of environmental welfare as follows. $M_1$and M_2 are reference points of pollution in per capita terms so that E_1, E_2 measure environmental quality with respect to an observed maximum. The resulting marginal effect of A on E is

$$\frac{\partial E}{\partial A} = \gamma_1 \cdot \frac{E}{E_1}\frac{\partial E_1}{\partial A} + \gamma_2 \cdot \frac{E}{E_2}\frac{\partial E_2}{\partial A} + (1-\gamma_1-\gamma_2)\cdot \frac{E}{E_3}\frac{\partial E_3}{\partial A} + \left(\gamma_1 \cdot \frac{E}{E_1}\frac{\partial E_1}{\partial N} + \gamma_2 \cdot \frac{E}{E_2}\frac{\partial E_2}{\partial N} + (1-\gamma_1-\gamma_2)\cdot \frac{E}{E_3}\frac{\partial E_3}{\partial N}\right)\frac{\partial N}{\partial A},$$

where the γ's are unknown parameters that determine the weight of each component in the environmental index. Our calculations in table 3.18 assume that these weights are equal.

RNR impact on GDP volatility can be expressed as follows:

$$\frac{\partial \frac{1}{v}}{\partial A} = -\frac{1}{v^2}\left(\frac{\partial v}{\partial A} + \frac{\partial v}{\partial N}\frac{\partial N}{\partial A}\right).$$

Thus we can finally derive the elasticity of national welfare with respect to RNR by inserting the expanded expressions for marginal effects of A on *y, y1, E and 1/v,* into equation (2) above:

$$\begin{aligned}\frac{dU}{dA}\frac{A}{U} = {} & \alpha\left(S_A + e_{N,A}\cdot S_N\right) \\ & +\beta\cdot\left(e_{y1,(A/L)} + e_{y1,(N/L)}\cdot e_{N,A}\right) \\ & +\gamma\left[\gamma_1\left(\frac{E_1'}{G\cdot E_1}\left(-e_{E_1',A}\right)\right)\right. \\ & +\gamma_2\left(\frac{E_2'}{G\cdot E_2}\left(-e_{E_2',A}\right)\right) \\ & +e_{N,A}\left[\gamma_1\left(\frac{E_1'}{G\cdot E_1}\left(-e_{E_1',N}\right)\right)\right. \\ & \left.\left.+\gamma_2\left(\frac{E_2'}{G\cdot E_2}\left(-e_{E_2',N}\right)\right)\right] \\ & \left.-\left(1-\gamma_1-\gamma_2\right)\left(e_{E_3',A} + e_{E_3',N}e_{N,A}\right)\right] \\ & -\left(1-\alpha-\beta-\gamma\right)\left(e_{v,A} + e_{v,N}\cdot e_{N,A}\right),\end{aligned}$$

where S_A and S_N are the sectorial GDP shares. This decomposition allows us to recover the marginal contribution of both sectors to national welfare. This chapter provides econometric estimates of the relevant elasticities.

Source: Bravo-Ortega and Lederman 2005.

3.2 The RNR sector and economic growth

As demonstrated by the quote at the beginning of this chapter, the literature on agriculture's role in economic development dates back to the work of the classic economists Adam Smith, David Ricardo, and Thomas Malthus. The modern literature includes numerous books and articles, including the influential works of Johnston and Mellor (1961), Hayami and Ruttan (1971, 1985), and Johnson (1997). There is an active current debate that is partly inspired by the fact that in many developing countries, agriculture still accounts for a significant share of GDP. Nonetheless, the dynamism of RNR production and its insertion into the rest of the national economy have also been the subject of study in industrialized, high-income countries where the RNR sector accounts for a small fraction of national income (for example, Gardner 2002). Some of the main contributions to this debate and cross-country econometric exercises addressing related issues are summarized in Timmer (2002).

The RNR sector's theoretical weaknesses and strengths

The RNR sector's theoretical weaknesses are: (a) the expansion of agricultural production is limited by the availability of a specific factor of production, namely land, which

TABLE 3.1

RNR and non-RNR GDP growth rates (annual averages for 1970–99 data at constant 1995 dollar)

Country	Growth of RNR (%)	Growth of the rest (%)
Argentina	2.3	2.0
Brazil	3.5	4.3
Chile	3.2	4.5
Colombia	1.9	4.3
Costa Rica	3.4	4.7
Dominican Republic	2.5	5.5
Ecuador	0.7	5.1
El Salvador	0.9	2.4
Guatemala	2.9	3.7
Guyana	2.1	–0.1
Honduras	2.4	3.9
Jamaica	1.6	0.6
Mexico	2.1	4.0
Nicaragua	1.2	0.4
Paraguay	4.2	4.8
Peru	2.1	2.2
Trinidad and Tobago	–1.0	3.2
Uruguay	1.1	2.2
Venezuela, R.B. de	2.2	1.8
Latin America and Caribbean average	2.1	3.1

Source: Authors' calculations based on World Bank and FAO data.

sets a ceiling in terms of how much can be planted, although technological and other improvements can generate tremendous increases in land yields (Ruttan 2002); (b) as household incomes grow, the share of consumption dedicated to the purchase of food and related items tends to decline. Both could be reflected in low RNR GDP growth rates when compared to non-agricultural GDP growth rates. In fact, table 3.1 shows that in most Latin American and Caribbean countries during the past decades, the average annual growth rate of RNR (commodity agriculture plus fisheries and forestry) activities has been lower than those of their non-RNR activities.

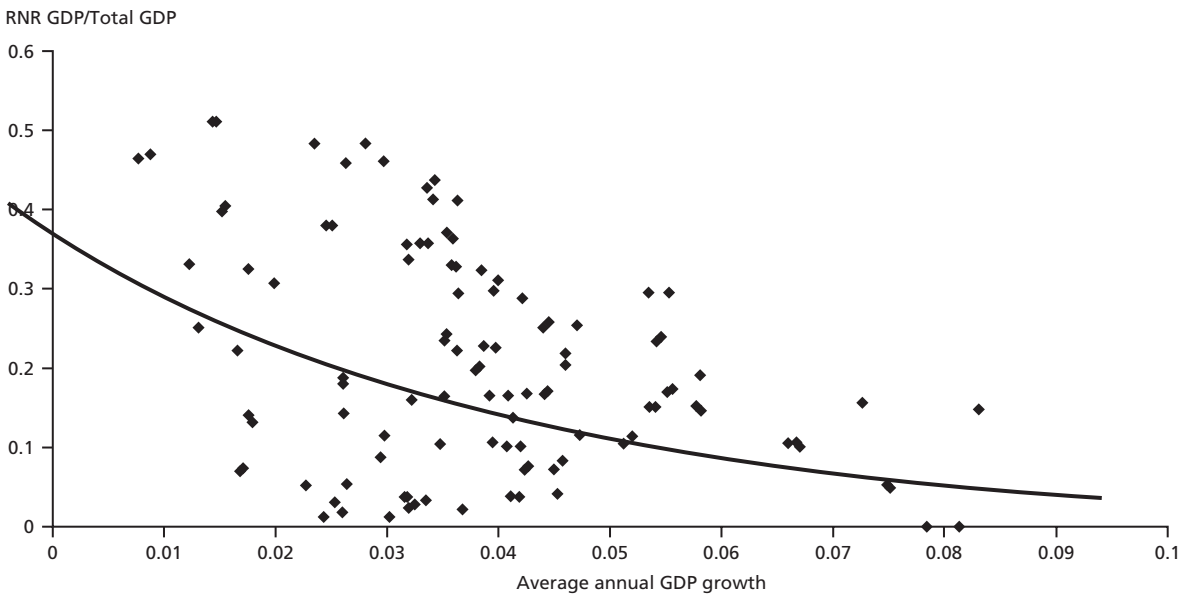
Some observers have provided another pessimistic view of the RNR sector related to productivity growth. As discussed in De Ferranti et al. (2002), a variety of development specialists, ranging from Prebisch (1959) to Sachs and Warner (1995), have argued that natural-resource-intensive sectors, including the RNR sector, have low potential to stimulate fast productivity growth. We can safely discard this alleged weakness since there is substantial empirical evidence that demonstrates that agricultural productivity growth tends to be substantially higher than growth observed in manufacturing industries in developed and developing countries alike (Martin and Mitra 2001; Bernard and Jones 1996a and 1996b). De Ferranti and his coauthors discuss this evidence in detail, and later in this report (chapter 5) we provide additional estimates of RNR productivity growth in Latin American and Caribbean countries and in other regions of the globe. In the meantime, it suffices to observe that the RNR sector's relatively lower growth rates are not due to low productivity growth but are probably due to the other two factors mentioned in the previous paragraph.

Nevertheless, the fact that the RNR sector's GDP share tends to decline with development throughout the developing world says very little about the economic forces behind the decline of the RNR sector. Johnston and Mellor (1961) provided five reasons why RNR activities, including fisheries and forestry, can actually have a positive impact on non-RNR development: (a) demand for agricultural products can rise with development and lack of supply can obstruct growth; (b) agricultural exports can help reduce foreign exchange constraints; (c) the manufacturing labor force has to be drawn from agricultural production with rising labor (and land) productivity; (d) agriculture can contribute to national savings and provide capital for investment; and (e) rising incomes of the rural population dedicated to farming can expand demand for other products. All these arguments are now outdated for a world economy where imports can satisfy domestic demand for food and agricultural products. Furthermore, as mentioned above, technological progress in agriculture seems to have been more rapid, at least in terms of measured total factor productivity growth, than in manufacturing, in both developed and developing countries. This finding could imply the existence of technological spillovers, whereby technological improvements in the RNR sector have positive effects on the technological progress in the rest of a national economy. In any case, there are plenty of reasons to rigorously explore the potential contribution of RNR-sector development to national economic growth beyond the calculations of the GDP shares with and without linkages, as done in chapter 2.

The relationship between the RNR sector's size and overall economic growth

The RNR sector's relatively lower growth rates in comparison to the rest of the economy does imply a declining RNR GDP share, but it does not mean that overall economic

FIGURE 3.1
RNR sector's GDP share and GDP growth, 1960–2002



Source: Authors' calculations based on World Bank and FAO data.

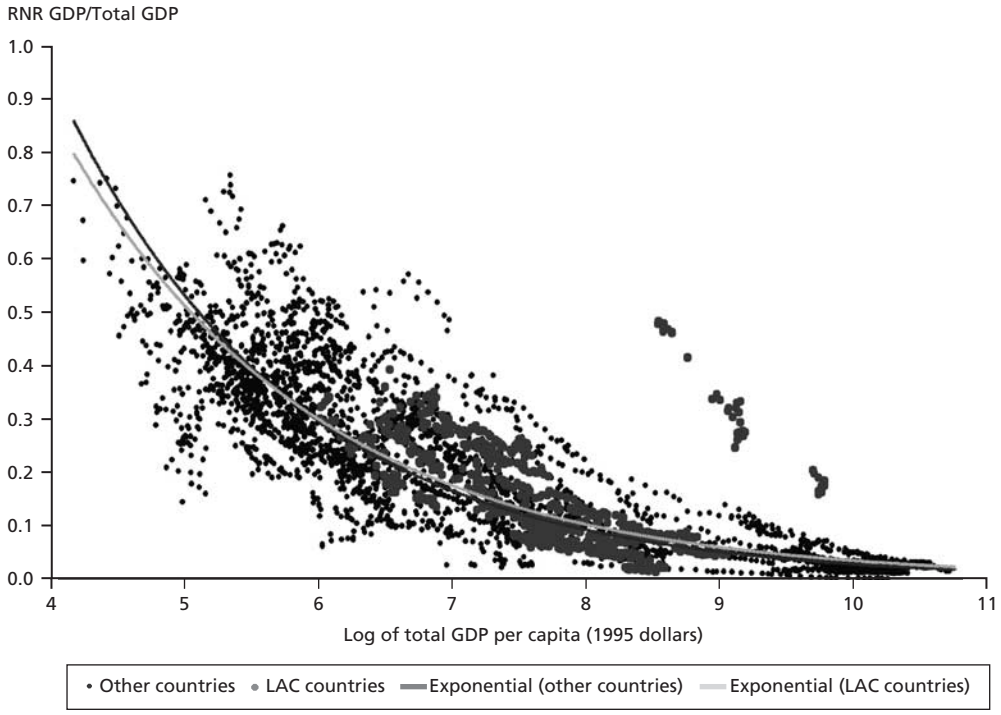
growth will be slower as a consequence of the RNR sector's decline. Figure 3.1 provides descriptive evidence to support this claim. It shows the relationship between the RNR sector's share in national GDP and the national GDP growth rate for a large sample of countries. The data suggest a negative correlation between the RNR share and overall national economic growth. While this evidence is not being used here as a proof that a declining share of the RNR sector is caused by vigorous economic growth, the data does suggest that a declining share of the RNR sector is not necessarily a bad outcome in terms of national economic development.

A complementary question is whether lower RNR GDP shares in the national economy imply that countries are poorer, a topic that was previously studied by many development and agricultural economists, including Chenery and Syrquin (1975). This issue is illustrated in figure 3.2, which shows the relationship between RNR GDP shares and the development level, as opposed to the growth rate of national GDP presented in the previous graph. The two linear regression lines shown in figure 3.2 correspond to the correlation between the RNR GDP share and GDP per capita for the whole sample of over 120 countries and the sample of over 30 Latin America and Caribbean countries. In both sets of countries, the correlation is negative, thus implying that the RNR share in national GDP tends to decline with economic development.

Despite this descriptive evidence, figures 3.1 and 3.2 do not prove that a declining share of the RNR sector is necessarily a good outcome. The descriptive statistics contained in those graphs also do not prove that the RNR sector's decline rate, as a percentage of the national GDP, is necessarily the same for Latin American and Caribbean countries as it is for other countries. Understanding why this is so requires a bit of technical analysis, which appears in box 3.2. Therefore, to assess whether some Latin American and Caribbean countries have experienced abnormally fast declines in their RNR-sector shares, we need to go beyond the simple descriptive statistics shown in figure 3.2. For example, since Latin American and Caribbean countries on average tended to have lower RNR GDP shares than other poor countries during 1960–2000 (15.0 percent versus 27.8 percent, excluding the food-processing industries), the former could have experienced slower rates of decline of their RNR GDP shares (that is, they could have lower absolute values of the parameter discussed in box 3.2).

FIGURE 3.2

RNR sector's GDP share and income per capita (annual data from 1960–2002)



Source: Authors' calculations based on World Bank and FAO data.

BOX 3.2

The relationship between RNR GDP share and development

The relationship between the RNR sector's share in national GDP and the process of economic development can be formally expressed as follows:

$$(1) \quad as = \beta \cdot \ln(y_{pc}),$$

where *as* corresponds to the RNR share in GDP, and $\ln(y_{pc})$ is the natural logarithm of income per capita. Simply put, the RNR GDP share falls with development whenever β is negative. Let $as = \frac{A}{Y}$, where A is the RNR output and Y is total GDP. Also, define per capita income as $y_{pc} = \frac{Y}{POP}$, where *POP* is national population. After some algebra, β can be expressed as:

$$(2) \quad \beta = \left(\frac{dA}{A} - \frac{dY}{Y} \right) \frac{1}{\left(\frac{dY}{Y} - \frac{dPOP}{POP} \right)} \cdot \frac{A}{Y}.$$

Equation (2) implies that the RNR sector's growth rate needs to be lower than GDP growth in order for β to be negative, which is generally the case for most of the world and for Latin American and Caribbean countries in particular (see table 3.1). Also, positive long-run growth rates of GDP per capita observed around the world and in Latin American and Caribbean countries imply that the expression within parentheses in the denominator on the right-hand side of (2) is positive. Furthermore, equation (2) shows that β, or the pace of decline of the RNR sector's GDP share, tends to be faster in countries with a larger share of agricultural GDP. This implies that we should, in fact, observe international heterogeneity in the magnitude of β, since national growth rates and the share of agriculture do tend to vary greatly across countries and regions.

Source: Bravo-Ortega and Lederman 2005.

TABLE 3.2

Regression results: The negative relationship between the RNR sector's GDP share on the development level holds across the globe

Estimation method	(1) OLS	(2) FE	(3) FE	(4) FE	(5) FE IV	(6) FE IV	(7) FE IV	(8) FE IV	(9) FE IV	(10) FE IV
GDP per capita (log)	–0.0823	–0.129		–0.1177	–0.1263	–0.1378	–0.1775	–0.4188	–0.1671	–0.3866
	(0.0009)***	(0.0024)***		(0.0028)***	(0.0037)***	(0.0042)***	(0.0052)***	(0.0192)***	(0.0044)***	(0.0227)***
Times LAC countries									0.0592	0.3708
									(0.0125)***	(0.0867)***
Times high-income countries									0.1493	0.2788
									(0.0085)***	–0.1862
GDP per capita squared								0.0196		0.0167
								(00.0015)***		(0.0017)***
Times LAC countries										–0.0219
										(0.0055)***
Times high-income countries										–0.0118
										–0.0095
Trend			–0.0021	–0.0006		0.0005	–0.0043	–0.0033	0.0000	–0.0001
			(0.0001)***	(0.0001)***		(0.0001)***	(0.0004)***	(0.0007)***	–0.0001	–0.0001
Trend squared								0		
								(0.0000)***		
Trend times GDP per capita (log)							0.0007	0		
							(0.0001)***	–0.0001		
Sargan test P-values					0.00	0.12	0.40	0.51	0.73	0.93
Observations	3874	3874	3874	3874	2459	2459	2459	2459	2459	2459
R-squared (overall)	0.67	0.67	0.02	0.66	0.69	0.69	0.69	0.74	0.16	0.20
Number of countries		129	129	129	111	111	111	111	111	111

Source: Bravo-Ortega and Lederman 2005.
Note: Dependent variable = RNR GDP share; various specifications and estimation techniques. Standard errors appear in parentheses. * = significant at 10 percent; ** = significant at 5 percent; *** = significant at 1 percent. Instruments used in the FE IV are lags 5–15 of (log) GDP per capita. LAC = Latin America and the Caribbean.

To further study the empirical relationship between the RNR GDP share and the level of development, table 3.2 presents econometric estimates of the rates of decline of the RNR-sector's GDP share across several specifications and estimations methods. All estimations use annual data, but columns (2)–(10) present estimates of the average negative correlation between RNR GDP shares and GDP per capita across countries over time. That is, we are capturing how the RNR GDP shares vary within countries over time.[1] In all of them we observe a negative correlation between the relative RNR sector size and the development level.

Models (3)–(4) and (6)–(8) also include a time trend, which is also statistically significant. This implies that the RNR sector's GDP share has tended to decline in all countries with a common implicit trend. Moreover, regression (8) includes dummy variables identifying high-income and Latin American and Caribbean countries multiplied by the log GDP per capita of the corresponding countries. This implies that the reference group is composed of non-Latin American and Caribbean developing countries. The Latin American and Caribbean rate decline of the RNR GDP share is thus the sum of the coefficient on the log of GDP per capita variable plus the coefficient on the log of GDP per capita multiplied by the Latin American and Caribbean dummy variable. As predicted by theory, the results show a stronger negative relationship for the reference group, a weaker negative relationship for Latin America and the Caribbean, and an insignificant coefficient in high-income countries (see table 3.2).

It is also possible that the relationship between the RNR share in national GDP and the development level could be different across Latin American and Caribbean countries. To assess whether some Latin American and Caribbean countries experienced abnormally high rates of decline of their RNR sectors relative to national GDP, we implemented econometric tests of whether each Latin American and Caribbean country experienced unique rates of decline of the RNR-sector's share. These results are presented in table 3.3, which contains an estimate of the relevant coefficient for the average Latin American and Caribbean country in the first row and lists the statistically significant differences in the subsequent rows for each Latin American and Caribbean country.

Thus for each country in the table, the coefficient linking the RNR sector GDP share and the development level (represented by the log of GDP per capita) for each Latin American and Caribbean country is the sum of the coefficient for the Latin American and Caribbean average plus each country's deviation from that average. All 20 Latin American and Caribbean countries analyzed in this exercise experienced declines in the RNR sector's GDP share with development, and only a handful of Latin American and Caribbean countries experienced significantly different rates of the RNR sector's decline during 1960–2000 (see table 3.3).

The slowest rate of decline occurred in Nicaragua, followed by Chile and Ecuador, whereas the fastest decline was experienced by Colombia, followed by the Dominican Republic. From this evidence it is impossible to conclude that fast declines in the RNR sector are per se a symptom of weaknesses in the RNR sector's potential contribution to long-term national development in Latin American and Caribbean countries. For example, we know that Chile's vigorous economic growth since the mid-1980s was driven by natural resource and agricultural production, thus producing a slower decline in these sectors' GDP shares. Countries

TABLE 3.3

RNR GDP share falls with development in all Latin American and Caribbean countries (econometric estimates: FE IV regressions with annual data, 1960–2000)

LAC average coefficient	–0.11
Country-specific deviations	
Argentina	NS
Bolivia	NS
Brazil	NS
Chile	0.08***
Colombia	–0.16***
Costa Rica	NS
Dominican Republic	–0.10**
Ecuador	0.08***
El Salvador	NS
Guatemala	NS
Guyana	NS
Jamaica	NS
Mexico	NS
Nicaragua	0.10***
Nonduras	NS
Panama	NS
Paraguay	NS
Peru	NS
Trinidad and Tobago	NS
Uruguay	NS
Venezuela, R.B. de	NS

Source: Regressions by Bravo-Ortega and Lederman, based on data from the World Bank.
Note: Coefficients were derived from a fixed–effects instrumental variables (IV) estimator. The IVs were the (demeaned) explanatory variables that lagged 5–15 years. ** = Significant at 5 percent and *** = significant at 1 percent level; NS = not statistically different from the LAC average. LAC = Latin America and the Caribbean.

that have experienced rural violence, such as Colombia, might have experienced faster declines in their agricultural GDP shares as factors of production, including labor, migrated out of conflict areas. In the case of the Dominican Republic, it is well known that dynamic tourism and export-processing zones have attracted a substantial number of workers, which could explain this country's relatively fast decline of its RNR sector's GDP share.

Thus far the analysis has focused on the decline of the RNR sector's share in national income, but there is a closely related literature on the decline in the share of the workforce employed in agricultural production. Larson and Mundlak (1997) used census population data for 98 countries to study the migration of workers from agriculture to other economic activities during 1950–1990.[2] These authors found that the average migration rate for the whole period was about 2.2 percent per year above the total labor force's rate of increase. That is, about 2.2 percent of agricultural workers moved to off-farm activities above and beyond the total national labor force's rate of increase. Their data for 23 Latin American and Caribbean countries indicate that the region's average intersectoral migration rate was about 2.6 percent in the 1970s and 2.35 percent in the 1980s. These rates were higher than for the 27 African countries (1.35 percent in the 1980s) and for the 11 Asian countries (1.8 percent in the 1980s). Larson and Mundlak also found that this labor migration was driven by potential income gains, whereby higher incomes in off-farm activities attract workers.

Readers should note that the migration rates that Larson and Mundlak calculated probably underestimate the pace at which labor flows out of agricultural activities, because they treated any worker as being employed in agriculture as long as the individual reported receiving some income from agriculture. Consequently, workers with diversified sources of farm and off-farm income were considered to be strictly employed in agriculture.

In any case, this evidence on sectoral employment dynamics suggests that the process of decline in the RNR sector's GDP share is accompanied by a corresponding inter-sectoral migration of workers. And this phenomenon says very little about the desirability of maintaining workers in one or another economic activity. Box 3.3 discusses new evidence concerning the determinants and consequences of rural-urban migration in Bolivia. This case study plus the evidence on the determinants of nonfarm income sources in Mexico and El Salvador discussed in chapter 2 suggest, indeed, that it is quite possible that any public policy that reduces barriers to labor migration across economic activities can be quite productive from a national welfare viewpoint.[3]

BOX 3.3

Rural-urban migration in Bolivia

In the background work by Tannuri-Pianto et al. (2004), migrant is defined as an individual who has moved to a different city or locality in the past five years, excluding individuals migrating from foreign countries. This is the only definition that allows comparability across surveys (EIH 1993, ENE 1997, MECOVI 2002). The MECOVI 2002 survey does not identify the birthplace of migrants. The ENE 1997 provides information about the birthplace of individuals. The EIH 1993 has the most complete migration data, including birthplace and how many years since migration. The 2001 census data is used to determine if a migrant's place of origin is urban (more than 2,000 inhabitants), rural (less than 2,000 inhabitants), or metropolitan. Even though analyzing only recent migrants has the drawback of not fully allowing their assimilation at destination, it has the advantage of restricting the sample to a more homogeneous group. The results apply to migrants at an early stage of integration into the urban economy.

The analysis is based on Roy's model (1951) applied to an international migration context by Borjas (1999). Migration is costly and only occurs if net benefit (income differential minus cost) is positive.

This implies that the earnings of migrants are only observed in the destination area (who chose to leave), while the earnings of nonmigrants are observed in origin (who chose to stay), which induces potential selection bias in ordinary regressions. This sample selection problem inherent to the migration model (nonobservable characteristics that influence the decision to migrate) is resolved by implementing a two-step method. In the first step, an individual's migration probability is estimated and included in the second step, earnings equations for migrants at the destina-

BOX 3.3 ***continued***

tion, to correct for the fact that we only observe earnings of individuals who have migrated.

This model is appropriate to describe choices and earnings of average migrants, but presumes that gaps in average earnings fully characterize the situation of migrant workers at all points of the earnings scale. Also, returns to migration may vary across workers that come from and insert themselves into different points of the conditional wage distribution due to, for example, their endowment of unobserved skills or to differential opportunities (crowding effects) in the labor market. Moreover, selection biases may vary along the earnings distribution, for example, motivations and opportunity costs differ between migrants at the bottom and top of the distribution.

The motivations and opportunities of individuals at the top of the earnings distribution are likely to be different from those of individuals at the bottom. Therefore, Tannuri-Pianto and coauthors estimated quantile earnings equations for migrants and nonmigrants in urban regions in Bolivia, correcting for selectivity bias using the methodology that Buchinsky (1998) developed. The models are corrected for self-selectivity in 1997 and 2002, but not in 1993, because of a lack of data at origin, and include the Human Development Index (HDI) and its various components at the level of municipal sections (*seccion*) as a variable correlated with the migration decision but not with earnings at destination. The probability models were estimated using Ichimura's (1993) semi-parametric least squares, but were not very different from the results from probit models.

The analysis shows that the migration flow pattern conforms with the human capital theory, which postulates that younger and better educated heads of household, with smaller families, seeking more developed areas, are more likely to migrate. A very interesting feature of the migration process in Bolivia is that rural migrants do not come from the poorest or least developed areas and that communities with higher education levels discourage migration, maybe because of the positive externalities generated by education. Moreover, there is significant reversed migration from urban or metropolitan to rural areas.

Returns to migration are positive at low and median quantiles and migrants' returns to all education categories, except university, are higher than those for nonmigrants in 2002. Selectivity is negative at low quintiles in 1997 and 2002. Although migrants represent a relatively more educated segment of the rural population, they tend to insert themselves into the lower part of the urban or metro conditional earnings distribution as their likelihood of migration decreases, and unobserved heterogeneity plays a stronger role, eroding some of migration's benefits.

Interestingly, despite the fact that rural-to-urban migrants at the low and median quintiles of the conditional earnings distribution enjoy an earnings premium (especially women), there is not significant queuing for the lower tier urban jobs that would erode this earnings advantage. This and the fact that there is significant reversed migration are consistent with nonpecuniary benefits of living in rural areas. This is consistent with the results of Arias and Sosa (2004) who concluded that location effects matter for both income and self-rated poverty, but there may be nonmonetary benefits associated with living in particular regions that are misrepresented by geographic income poverty rankings. They find that once they control for indicators of access to assets and basic services (for example, water, electricity), rural residents are equally likely to self-rate as poor as the urban inhabitants, but they continue to be more likely to be income-poor.

This suggests there might be room for policies that lower migration costs and facilitate migrants' assimilation into urban labor markets, such as child care centers and job search posts. In rural municipalities where significant pockets of poverty coexist with relatively high but unequally distributed incomes, there is greater room for accompanying growth investments with smart redistribution mechanisms, such as conditional cash transfers and targeted investments to support the proactive activities of the poor. In cases where proactive activities are not economically viable or the cost of infrastructure provision is too high, a gradual integration to neighboring intermediate communities (for example, migration) might be the best alternative, and there pro-migration policies that lower integration costs to urban labor markets can play an important role.

Source: Written by Omar Arias (World Bank).

Causal effects of the RNR sector on other economic activities

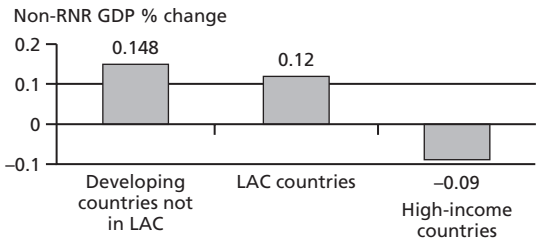
To study the causal effects of RNR growth on the development of the national economy as a whole, we conducted additional statistical analyses. More specifically, we studied the empirical relationship between the RNR sector's size in a given year and the non-RNR sector's size in the subsequent year, while at the same time controlling for the non-RNR sector's size in the same year. Nobel-prize-winning economist Clyde Granger (1969) suggested this type of causality analysis, but here we applied it to panel data covering countries over time since the early 1960s, as Arellano (2003) suggested. The analyses of these causal relationships that Bravo-Ortega and Lederman (2005) described in detail, also compared the RNR sector's causal effects on the rest of the national economy in Latin American and Caribbean countries with those observed in the other developing and developed countries.

Figure 3.3 illustrates the results. This graph shows the estimated percent increase in the non-RNR sector associated with a one-percent increase in the RNR GDP for Latin American and Caribbean countries, other developing countries, and high-income developed countries. The developing countries, including Latin America and the Caribbean, seem to have experienced positive effects emanating from the RNR sector to other economic activities during 1960–2000, while the developed high-income countries experienced negative effects from the RNR sector. The estimate for the non-Latin American and Caribbean developing countries is a bit higher than for Latin American and Caribbean countries, but the difference is not statistically significant, and thus we cannot conclude that the RNR sector's positive effects on the rest of the economies of Latin American and Caribbean countries are different from the effects on other developing countries. But we can conclude that RNR growth in high-income countries tends to pull significant resources away from the other activities. The strong resource-pull effect found in the high-income countries could be associated with the high protection level (import barriers and subsidies) that favors agricultural activities in these countries, especially since the mid-1980s. Furthermore, Bravo-Ortega and Lederman (2005) argue that these findings are consistent with the characteristics of agricultural growth in countries such as the United States, where notable productivity (or input-saving) growth has attracted human capital into the sector (see also Acquaye et al. 2003).

Figure 3.4 shows the reverse effects going from non-RNR activities to the RNR sector for the three groups of countries. This evidence suggests that Granger causality also goes from the rest of the national GDP to the RNR sector only in non-Latin American and Caribbean developing countries. However, this effect is negative, implying that in these countries there is a predominant resource-pull effect, whereby growth in the rest of the economy leads to a shrinking of the RNR sector. The estimates of this effect for the Latin American and Caribbean and high-income countries are not statistically different from zero.

FIGURE 3.3

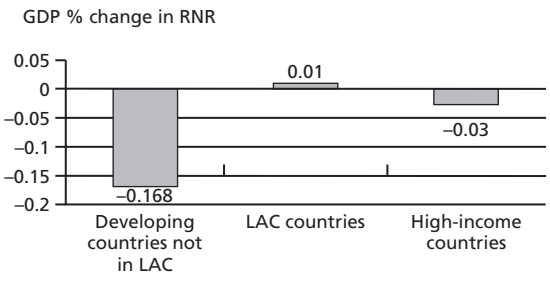
Impact of a 1 percent increase in RNR GDP on the rest of the national economy the following year



Source: Granger causality tests from Bravo-Ortega and Lederman (2005, table 3b).
Note: LAC = Latin America and the Caribbean.

FIGURE 3.4

Impact of a 1 percent increase in non-RNR GDP on the RNR sector



Source: Granger causality tests from Bravo-Ortega and Lederman (2005, table 3b).
Note: LAC = Latin America and the Caribbean.

Diversity in the Latin America and Caribbean region

Chapter 2 discussed the linkages between commodity RNR activities, such as agriculture, fisheries, and forestry, and the downstream industries associated with the production of processed foods, beverages, and other manufacturing activities that use RNR commodities as production inputs. The country cases discussed therein suggested that Chile's basic RNR sector has the strongest linkages with downstream industries, followed by Mexico's, and lastly Colombia's. These findings imply that there might be significant heterogeneity across Latin American and Caribbean countries in terms of the positive multiplier effects going from the commodity RNR sector to other industries and vice-versa.

The estimates under the first column of table 3.4 explore the Latin American and Caribbean region's potential diversity. It provides estimates of country-specific deviations from the average Latin American and Caribbean effect of the basic RNR sector on other economic activities and vice-versa. The evidence suggests that there is substantial heterogeneity in the Latin American and Caribbean region, because the appropriate econometric tests suggest that we cannot reject the possibility that most Latin American and Caribbean countries have experienced cross-sector effects different from those of the region's average. Moreover, the results suggest that Chile has one of the highest positive effects of the RNR sector on other economic activities, whereas Mexico is just a bit above the Latin American and Caribbean average, and Colombia has just about the region's average. These three cases are interesting because these were the countries whose inter-sector linkages were studied in chapter 2. Therein we concluded that Chile had the strongest linkages between the RNR sector and other

TABLE 3.4

Cross-sector Granger causality: Heterogeneity across Latin American and Caribbean (LAC) countries

	% change in non-RNR GDP due to a 1 % rise in RNR GDP (1)	% change in RNR GDP due to a 1 % rise in non-RNR GDP (2)
LAC effect[a]	**0.12**	**0.02**
	Deviation from average LAC effect	
Argentina	0.53***	0.37***
Brazil	0.57***	N.S.
Chile	1.29***	0.24***
Colombia	N.S.	–1.17***
Costa Rica	N.S.	–0.58***
Dominican Republic	N.S.	–0.38***
Ecuador	N.S.	N.S.
Guatemala	0.63***	–1.73***
Guyana	0.45***	–0.45***
Honduras	N.S.	N.S.
Jamaica	0.79***	–0.32***
Mexico	0.17*	–0.28***
Nicaragua	0.63***	N.S.
Panama	1.07***	0.32**
Peru	0.24**	–0.22**
PRI	0.22**	–0.19**
Paraguay	N.S.	N.S.
El Salvador	N.S.	0.24**
Trinidad and Tobago	N.S.	N.S.
Uruguay	–1.27***	0.62***
Venezuela, R.B. de	N.S.	0.62***

Source: Regressions by Bravo-Ortega and Lederman, based on data from the World Bank.
Note: All regressions were estimated with the Arellano-Bover (1995) one-step GMM System estimator; * = significantly different from LAC at 10 percent; ** = significantly different from LAC at 5 percent; *** = significantly different from LAC at 1 percent.
a. These average LAC effects are slightly different from those in figures 3.3 and 3.4, because the estimation method is different. The regression results presented in figures 3.3 and 3.4 were derived from the two-step GMM system estimator.

industries, followed by Mexico and Colombia, in that order. Thus the econometric evidence presented in table 3.4 is consistent with the case study evidence, since stronger inter-sector linkages are expected to yield higher multiplier effects from the RNR sector to the rest of the economy.

An interesting pair of findings in the first column of table 3.4 concerns Chile and Uruguay. In the former, the RNR sector has had positive effects on the rest of the economy, and the magnitude of this effect could be greater than one. This implies that the RNR sector's growth in Chile has been associated with an additional increment in the size of the rest of the economy: for each one-percent increase in the RNR sector's size, the rest of the economy has tended to grow, on average, by 1.41 percent (that is, the average Latin American and Caribbean effect of 0.12 plus Chile's additional effect of 1.29 percent). In contrast, in Uruguay, a one-percent growth of the RNR sector has been associated with a more-than-proportional *decline* in the rest of the economy of about 1.15 percent, although this estimate is not statistically different from one. In this case, it is possible that Uruguay's RNR sector has been highly efficient during the past few decades, and consequently this sector tends to attract productive resources. Unfortunately, we have no means for testing this hypothesis since Uruguay's data availability on the factors used for agricultural production is quite limited, and thus not included in the analysis of RNR-sector productivity discussed further in this chapter.

Regarding the reverse effects, namely, the impact of the rest of the economy on the RNR sector's size, the estimates listed in the second column of table 3.4 also show substantial heterogeneity in the Latin American and Caribbean region. Colombia and Guatemala are two outliers in that their growth of non-RNR activities has been associated with more-than-proportional declines in the RNR sectors. Although these average effects might not be statistically different from one, it is worthwhile to investigate if these countries have policies in place that might unduly discriminate against the allocation of production factors into RNR activities or whether these experiences were driven by the incidence of rural violence.

Finally, the cases of Chile and Argentina are worth highlighting. Both of these countries seem to have experienced strong positive feedback effects from both sectors. That is, both of these cases show positive cross-sector effects in either direction, which reflects strong linkages or spillover effects between RNR activities and the rest of the economy.

The impact of the RNR sector plus the food-processing industries on other economic activities

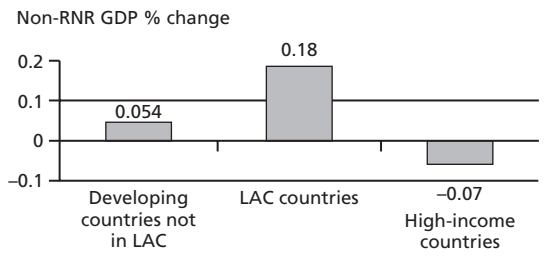
Since the basic RNR sector has positive effects on other economic activities in Latin American and Caribbean countries, it is also possible that the downstream industries, namely the food-processing industries, can also have effects on other sectors. After the chapter 2 discussion, it is also clear that the rural sector's size changes with various definitions of "rural" activities. Consequently, the rural sector can be defined so as to include the food-processing industries. As such, it is worth exploring the impacts of this larger rural sector on the rest of a typical Latin American and Caribbean economy.

Figure 3.5 illustrates the results from additional econometric estimates linking this broader definition of rural activities (that is, the basic RNR sector plus the food-processing industries) with the subsequent size of the remaining national GDP. These results are analogous to those presented for the more strict RNR sector definition in figure 3.3. This evidence indicates that the positive effect of the extended-RNR sector is substantially higher in Latin American and Caribbean countries than elsewhere in the world. In fact, this effect is also a bit higher when the food industries are included than when they were excluded (compare 0.12 in figure 3.3 with 0.18 in figure 3.5). Thus it is possible that in the typical Latin American and Caribbean country, the positive spillover and multiplier effects are stronger when the RNR sector's downstream industries are considered to be part of the rural economy in the region[4] (see figure 3.5).

The evidence presented thus far in this chapter has important policy implications. First, making policies based on sectoral targets, such as attempting to maintain a constant or

FIGURE 3.5

Impact of a 1 percent increase in RNR plus food industries' GDP on the rest of the national economy the following year



Source: Granger causality tests from Bravo-Ortega and Lederman (2005, table 3b).
Note: LAC = Latin America and the Caribbean.

rising RNR GDP share as advocated for the case of Mexico by Romero and Puyana (2004), for example, can be counterproductive from the national development viewpoint. This is a clear implication of the findings that a declining sector share is precisely what can be expected from a dynamic developing economy. In other words, providing special incentives, such as protection from international competition for the RNR sector, can actually retard rather than accelerate overall economic growth. Second, Latin American and Caribbean countries would be well advised to continue to experiment with public policies that aim to strengthen the linkages between the basic RNR sector and the downstream industries. The precise design of such programs can vary across countries, depending on rigorous analyses of the bottlenecks that prevent the establishment of such linkages. This recommendation is based on the findings that (a) the average Latin American and Caribbean countries have experienced larger positive developmental effects of the RNR-food sectors than other developing and high-income countries, and (b) the multiplier or positive externalities effects of RNR activities have been highest in countries, such as Chile, that have the strongest linkages with the downstream industries. Third, national policies should aim to make the necessary investments in the provision of public goods that stimulate efficiency in RNR activities.

More detailed discussion of policy issues is presented in subsequent chapters (5–9). The following section turns to the related issue of how RNR growth affects the income of poor families.

3.3 The RNR sector and income of the poorest households

There is little doubt that economic growth reduces poverty (for example, Dollar and Kraay 2002), but the growth of different economic sectors might have different impacts on the incomes of poor households. For instance, poor families can be concentrated in rural areas. Although calculations of multicountry poverty rates are notoriously unreliable due to data-comparability problems, Wodon (2003) reports dramatically different rural and urban poverty rates for Latin America and the Caribbean: as of 2001, there were about 65 million people living in moderate poverty in rural Latin America and the Caribbean, or about 53 percent of the official rural population. In contrast, there were about 110 million urban poor, accounting for about 29 percent of the urban population in Latin America and the Caribbean. Consequently, there is a vast literature on the relationship between the RNR sector's size and growth and incomes of the poorest households within countries. There are three principal ways by which more rapid growth of agriculture can affect poverty: (a) by increasing the quantity demanded and the wages of unskilled workers in all sectors of the economy, not only in agriculture; (b) by increasing poor farmers' incomes, to the extent that they share in the sector's growth; and (c) by raising consumers' real incomes resulting from lower food prices. These are effects mediated by markets and are not unique to agriculture. The question is, does the RNR or agricultural sector yield these pecuniary externalities to a greater degree than other industries?

Irz et al. (2001) argue that agricultural productivity growth can have important pro-poor effects through various channels, ranging from lower food prices that benefit poor households throughout an economy to increases in labor demand that arise from improvements in land yields. Many of these arguments are similar to the numerous concepts related to the intersectoral effects discussed in the previous section. These authors provide econometric evidence suggesting that the percentage of the national population that earns less than a $1 a day tends to decline with improvements in both agricultural value-added per worker and land yields. Unfortunately, Irz and his coauthors did not control for the potential contribution of other economic sectors to poverty reduction. In contrast, Ravallion and Datt (1996) do not find any impact of Indian manufacturing growth on the poor, even in urban areas, whereas rural growth reduced poverty in both rural and urban areas. More specifically, these researchers found elasticities of national poverty levels with respect to agricultural growth on the order of –1.2 to –1.9; and, importantly, they find an elasticity of *urban* poverty levels with respect to agricultural growth of –0.4 to –0.5. In contrast, secondary sector growth has no significant poverty reduction effect.

Using international data, Gallup, Radelet, and Warner (1997) find that a one-percent growth in agricultural GDP per capita leads to a 1.61 percent increase in per capita income of the bottom quintile, whereas an equivalent increase in industrial GDP increases the income of the bottom quintile by only 1.16 percent. Unfortunately, the data used by these authors only included 35 developing countries, and the differences in the sectoral effects were not statistically significant. Timmer (2002) studies the contribution of agricultural and non-agricultural output per worker to the income per capita across quintiles of the income distribution. Although he finds a slightly greater impact of agricultural

output, it is unlikely that the sectoral differences in his estimations were statistically significant.

Research compiled for this report comes from two types of analyses. The first follows closely the studies by Timmer and others using international data. The second comes from three Latin American and Caribbean case studies undertaken for the FAO Roles of Agriculture (ROA) project on economic development. The two cases covered here are Chile and Mexico, but we make some references to the experiences of the Dominican Republic and Brazil.

RNR activities and income of the poorest households

The data used in our statistical analyses on income shares across quintiles come from Dollar and Kraay (2002) and the World Bank's *World Development Indicators 2003*. The resulting data spans from 1960 to 2000. The econometric estimations use a panel of five-year averages. To study the contribution of RNR GDP to the income of different quintiles, Bravo-Ortega and Lederman (2005) estimated econometric models using techniques that deal with the endogeneity of the sectoral GDPs. More specifically, the GMM IV system estimations, which Bravo-Ortega and Lederman explain in detail, use appropriate lags of the sectoral GDPs as instrumental variables. A second innovation of the analysis undertaken by these authors is that it tests for the presence of international heterogeneity in the effects of the RNR sector and the rest of the economy on the average incomes of the poorest households. Thus here we compare the empirical effects that RNR growth has on the average income of poor households in Latin America and the Caribbean with those observed in high-income and other developing countries.

Table 3.5 reports the impact of output per worker in RNR and other economic activities on the income per

TABLE 3.5

RNR labor productivity's impact on household incomes across quintiles: Latin America and the Caribbean (LAC) versus other regions (effect of a 1-percent increase on the average household income, percent)

Income quintile	(1) GMM system Q1	(2) GMM system Q2	(3) GMM system Q3	(4) GMM system Q4	(5) GMM system Q5
RNR output per worker	0.3624	0.4426	0.423	0.3832	0.4121
	(0.1578)**	(0.1270)***	(0.1004)***	(0.1419)***	(0.1003)***
Non-RNR output per worker	0.6418	0.5622	0.5566	0.5969	0.6249
	(0.1585)***	(0.1892)***	(0.1046)***	(0.1421)***	(0.1186)***
RNR output per worker times LAC	–0.1716	–0.3214	–0.2512	–0.2558	–0.3448
	–0.2095	(0.1341)**	–0.1622	–0.157	(1.1131)***
Non-RNR output per worker times LAC	0.1303	0.2732	0.2263	0.2392	0.3378
	–0.1762	(0.1105)**	–0.1364	(0.1285)*	(0.0975)***
RNR output per worker times high-income	–0.2094	–0.4054	–0.3878	–0.4088	–0.4389
	–0.2438	(0.2105)*	(0.1586)**	(0.2016)**	(0.1393)***
Non-RNR output per worker times high-income	0.2615	0.4418	0.4286	0.4439	0.4294
	–0.2102	(0.1900)**	(0.1400)***	(0.1795)**	(0.1194)***
Observations	226	226	226	226	226
countries	84	84	84	84	84
Hansen's J-statistic p-values	0.87	0.68	0.84	0.95	0.96
LAC effect (p-values)					
RNR	0.10	0.01	0.06	0.01	0.00
Non-RNR	0.00	0.00	0.00	0.00	0.00
High-income effect (p-values)					
RNR	0.43	0.82	0.75	0.83	0.83
Non-RNR	0.00	0.00	0.00	0.00	0.00

Source: Bravo-Ortega and Lederman 2005.
Note: * = significant at 10 percent; ** = significant at 5 percent; *** = significant at 1 percent.

capita of each quintile, while also controlling for regional heterogeneity. The estimate for developing countries implies that a 1 percent increase in a country's RNR output per worker is associated with an increase of 0.36 percent in the average income of the poorest households. But RNR output per worker has a smaller effect than non-RNR output per worker on the average income of the first quintile, with an estimate implying that a 1 percent rise in this sector is associated with a 0.64 percent increase in the average household income of the poor. The Latin American and Caribbean estimates are 0.19 and 0.77 for the RNR and non-RNR sectors, respectively. But these estimates, as well as those of high-income countries, are not statistically different from those of the other developing countries. The finding that there is no significant international heterogeneity in the magnitudes of these regional effects has important policy implications, which are discussed further below.

There are some surprising results regarding the income of quintiles 2 through 5. First, improvements in RNR output per worker raise the income of quintiles 2 and 3 in developing countries. Second, growth of non-RNR output per worker raises incomes in all quintiles and all groups of countries. This impact is significantly larger for Latin America and the Caribbean quintiles 2, 4, and 5 than for other developing countries. This effect is even larger for high-income countries for quintiles 2–5.

In sum, the Latin America and the Caribbean *commodity* RNR sector has had, on average, small direct poverty-reducing effects, which are common throughout the world. In fact, the estimates imply that in Latin America and the Caribbean, a 1 percent increase in the commodity RNR sector is associated with a 0.12 percent rise in the rest of the economy. Consequently, this indirect effect on poverty implies that a 1 percent growth in the Latin American and Caribbean basic RNR sector is associated with an additional average increase in the incomes of the poor of almost 0.08 percent. In other words, a large portion of the RNR sector's poverty-reducing effect, namely 0.08 percent out of a total effect of 0.27 percent, operates through its positive effects on the rest of the economy. This poverty effect is large when compared to the RNR's low GDP share, which was about 12 percent in the sample of Latin American and Caribbean countries used in the analysis. Nonetheless, there might be interesting experiences within regions, and the international estimates presented here do not say much about the channels through which RNR or agricultural development helps fight poverty in Latin American and Caribbean countries. Thus the following subsection discusses the evidence compiled for the three Latin American and Caribbean countries under the aegis of the FAO ROA research project.

Case study evidence: Chile and Mexico

The ROA analysis for Chile by Lopez and Anriquez (2003) finds that unskilled labor demand is much more responsive to agricultural than non-agricultural growth, and the demand for unskilled workers is more sensitive to agricultural growth than the demand for skilled workers, with elasticity values of 0.58 and 0.44, respectively, as presented in table 3.6. It should be noted that agricultural output in this study included both primary production and the agro-industrial sector that depends on domestically supplied

TABLE 3.6

The effect of agricultural or rural prices and incomes on labor demand in Chile and Mexico (effect of a 1 percent increase of each variable on the labor demand, percent)

		Prices			Output	
		Unskilled labor	Skilled labor	Capital	Agricultural/rural	Non-agricultural/urban
Chile	Unskilled labor	–0.53**	0.21	0.32	0.58***	0.40***
	Skilled labor	0.07	–0.61***	0.54**	0.44***	0.70***
Mexico	Unskilled labor	–1.30***	0.28***	1.05***	0.22*	0.57***
	Skilled labor	0.42***	–0.55***	0.27**	0.06	0.88***

Sources: López and Anríquez 2003; Soloaga and Torres 2004.
Note: Standard errors in parentheses. *** = significant at the 1 percent level; ** = significant at the 5 percent level; *= significant at the 10 percent level. Elasticities evaluated at sample means. In the case of Chile, agricultural output includes primary production and the agro-processing sector related to domestic production. In the case of Mexico, rural and urban output is calculated from aggregate income levels (derived from household surveys) in rural and urban areas.

farm products. Increasing the share of the expanded agricultural output while keeping total output constant would lead to an expansion of employment of unskilled workers. In other words, a stagnant agricultural and agro-industrial sector would be unfavorable for unskilled workers. Depending on the value of the unskilled labor supply elasticity, for which there are no solid estimates, the elasticity of (national) poverty reduction with respect to agricultural growth ranges between 1.5 and 2.4, in contrast to a an economy-wide elasticity of approximately 1.0. That is, in Chile agriculture-based growth significantly reduces poverty, by raising employment and wages of hired labor. The effect on poverty of similar growth in the non-agricultural sector is more modest.

In the case of poor farmers, the analysis suggests that agricultural growth overall has contributed negligibly to raising their *farm-based* income (an elasticity of poor farmers' incomes with respect to agricultural growth of 0.1), due in part to the low participation of low income, small farmers in Chile's agro-export boom over the past two decades.[5] But the analysis showed that increases in the output of an expanded definition of agriculture sector—consisting of the primary sector and agro-processing—leads to significant gains in off-farm employment and income of poor farmers with an estimated elasticity of 1.0. The implication is that poor farmers are not directly participating in the Chilean farm sector's rapid growth, but they are participating indirectly through the increased employment generated by other farmers and by the agro-processing sector, which has been an integral part of the expansion of Chile's RNR growth.

As mentioned, agricultural expansion can lead to a decline in food prices, which in turn affects poverty in two ways: by raising household real incomes and by lowering the cost of the food basket that defines the poverty threshold.[6] In the case of Chile, much of the expansion in agriculture's GDP can be attributed to production of fruits, vegetables, and processed products oriented toward exports and to the production of some traditional import-competing goods, such as milk and grains. Because the country has a very open trade regime, one should not expect a significant impact of food production on the domestic prices of these products. Based on recent household survey data on budget shares for Chile, the analysis simulated the impact on poverty via reduced food prices due to an annual expansion of agriculture by 4 percent, which is close to recent trends.[7] The results, in fact, show that the poverty reduction level due to the fall in food prices would only be 0.73 percent. This is a marginal amount, for both the poor and vulnerable in Chile, but the situation for other countries with a more closed economy to trade and a food basket more heavily weighted toward nontradables would likely yield a higher impact of agricultural expansion on food prices and hence on household income.

In Mexico, rural poverty levels vary considerably by region. They are lower in the north and the Pacific region and are considerably higher in the south. The Soloaga and Torres (2004) ROA study incorporated this regional dimension into the analysis of the rural contribution to poverty reduction. As a source of household income, agricultural income represents a much higher share of income among the rural poor. For the 8.8 million people in *extreme* (food) poverty in rural areas (5.7 million in urban areas), farming represents 46 percent of total household income (and 18 percent for those in urban areas). For the 16.7 million people living in *moderate* poverty in rural areas (26.0 million in urban areas), agriculture represents 39 percent (8 percent in urban areas) of total household income. Furthermore, according to recent World Bank (2004) calculations, the incidence of extreme rural poverty (food poverty) in Mexico (34.8 percent) is much higher than the national level (20.3 percent), while extreme urban poverty is considerably lower (11.4 percent). But these data say little about the contribution of rural income growth, including agricultural income, to national poverty rates, because rural development can have poverty-reducing effects that go beyond the imaginary boundaries of Mexico's rural society.

Combining cross-sectional and time-series household data, the Mexico study followed the Datt and Ravallion approach and estimated the determinants of changes in rural and urban poverty rates by region during 1996–2001. Soloaga and Torres studied the possible distinct effects on people living in extreme and moderate poverty. In contrast to the Chile study and Datt and Ravallion, the analysis for Mexico distinguished between the "rural" and "urban" sectors. Rural and urban growth was based on calculations of incomes of rural and urban populations derived from household expenditure surveys.[8] Growth of both rural and nonrural sectors is associated with the reduction of poverty levels, but rural growth has a greater impact on the improvement of per capita consumption of the poorest in rural areas. Notably, rural growth has an effect on urban poverty for those people between the food poverty and the moderate poverty lines, but urban growth shows no similar linkages to rural poverty.

The primary mechanism by which rural growth alleviates poverty is supposedly through increases in the demand for unskilled workers. The evidence summarized in table

4.2 is not clear for the case of Mexico. On the one hand, rural growth has a higher labor-demand elasticity for unskilled workers than for skilled workers (0.22 versus 0.06). On the other hand, urban growth has a higher labor-demand elasticity for unskilled workers than rural growth (0.57 versus 0.22). This suggests that rural growth in Mexico might be more equitable, as it would increase relatively more the demand for unskilled workers than for skilled workers, but urban growth tends to produce more jobs for unskilled (and skilled) workers than rural growth. The low absolute magnitude of rural growth labor-demand elasticities in Mexico could be due to the fact, discussed in chapter 2, that rural incomes are highly diversified and improvements in income derived from subsistence farming or from migrant remittances might not necessarily lead to employment creation. Yet these income sources can affect wages of unskilled urban workers as such improvements might reduce rural-urban migration, thus raising urban wages.[9]

According to the aforementioned FAO studies for Mexico and Chile, the effects of rural growth on food prices apparently are small, especially if compared to the impact of real exchange rate fluctuations, again due to the importance of tradables. That is, variations of food prices in both countries closely follow the variations of world food prices plus exchange-rate fluctuations.

More generally, we do expect that rapid RNR growth and especially agro-industrial growth would tend to have a positive effect on the sector's employment and wages, especially of the unskilled, and that to some extent these effects would extend to the rest of a country's labor market. But these effects may not be significant in all circumstances. For example, in the case of the Dominican Republic, the very elastic labor supply in rural areas due to Haitian immigration was found to dampen rapid agricultural growth's effect on wages and employment of Dominicans. But it certainly helps poor households in Haiti. In other cases, the combination of an output mix characterized by extensive cultivation combined with capital-intensive production techniques may limit the effects that agricultural expansion can have on the wages of unskilled workers. This is perhaps the case of grain production in Argentine pampas and soybean production in Brazil. Thus, the output mix, the degree of mechanization, the supply elasticity of labor, and other variables also affect the magnitude of the impact that RNR activities can have on the incomes of poor families throughout an economy. The case of Chile illustrates situations where a significant segment of agriculture and agro-processing is labor-intensive, such as horticultural products for export with important post-harvest activities that also use unskilled labor (for example, packaging plants). Mexico is a case where rural income growth yields few jobs, but nevertheless raises incomes of poor urban families through other channels. Thus it is difficult to conclude that these cases can be easily replicated in other countries.

The Brazil case is thought-provoking. The 1990s was a decade of major transformation of Brazilian agriculture. As result of the trade liberalization, farm output prices fell, but the price of tradable inputs fell proportionately more, which favored the expansion of farm outputs. Between 1992 and 2001, agricultural production expanded by 37 percent, due to improved domestic terms of trade and to rapid growth in total factor productivity. But there was an apparent anomaly: labor demand in agriculture declined while agricultural wages increased, and rural poverty rates declined. During the 1992–2001 period, there was a 15 percent reduction in agricultural employment, but despite lower employment, farm real wages increased by 11 percent. In a recent study using household survey data, Paez de Barros (2004) seeks to explain these outcomes by focusing on factors related to labor supply rather than sectoral aggregate output. The evidence shows that farm real-wage increases can be linked to changes in job and worker characteristics and household demographics, such as higher levels of schooling and experience of farm workers, labor force participation, lower household size, as well as significant increases in rural nonfarm employment. Moreover, the observed reduction in food prices between 1993 and 1999 alone contributed to a reduction of 1 percentage point in extreme poverty in Brazil, although it is not clear if these reductions in prices were related to global and/or national trends.

Preliminary policy implications of poverty findings

In general terms, public policies can help reduce poverty by either shifting resources to economic activities that have the greatest poverty-reducing effect or by implementing reforms that enhance the poverty-reducing effect of the various economic activities. Our finding that the Latin American and Caribbean RNR sector has had significant direct and indirect poverty-reducing effects could be interpreted as evidence that biasing public policies in favor of agriculture and other RNR activities could be an effective means to fight poverty. Unfortunately, this is not quite right and can lead to policies that will actually worsen economic development's poverty-reducing effects, because the positive effects of non-RNR activities on the incomes of the poor in Latin America and the Caribbean

are absolutely higher than those of the RNR sector. This conclusion was supported by international evidence, which also showed that this is the average relationship in Latin America and the Caribbean and in the rest of the world.

The case study evidence from Chile and Mexico also supports this cautionary note. In the case of Chile, the downstream industries (food processing, and so on) induce the large effects on unskilled labor demand, which in turn reduces poverty. In the case of Mexico, the evidence that Soloaga and Torres (2004) provided is based on the behavior of total rural household incomes, which are highly diversified in that country. Related evidence from the Dominican Republic is mixed, and the recent analysis of the role of Brazil's agricultural boom in the 1990s in reducing rural poverty can be easily overstated, because it is not clear that the RNR sector's productivity improvements were the underlying cause of rural poverty reduction.

The fact that the international evidence is so robust, combined with the fact that we cannot reject the possibility that these relationships hold in Latin America and the Caribbean and in the rest of the world, implies that policies, such as land reforms that aim to enhance the poverty-reducing effects of RNR development, are probably not the best prescription for fighting national poverty in Latin American and Caribbean. Furthermore, there is strong empirical evidence that suggests that the effect of land tenure on rural household incomes in Latin America and the Caribbean countries is quite small. This implies that the amount of land to be given to poor rural families would need to be huge for this type of policy to have a noticeable poverty reduction effect (Lopez and Valdes 2000). Nonetheless, the poverty effects of RNR activities in Latin America and the Caribbean do seem to be larger than what is expected from this sector's low GDP share. Therefore, from the poverty reduction viewpoint, there is no evidence to support a tax or public investment structure that favors agricultural or RNR activities in an absolute sense, but there might be justification for RNR-biased policies if the benchmark is the sector's GDP share. Policy issues related to the allocation of public expenditures across sectors are discussed in chapter 5, and land-related policies that can affect the poverty effects of RNR growth are discussed in chapter 6.

As mentioned, national welfare is determined by a variety of considerations, where the incomes of the poor are but one important consideration. The following section explores the relationship between RNR activities and various environmental outcomes.

3.4 The RNR sector and the environment

Most empirical work on the interface between the environment and RNR activities (or agriculture) has centered on agricultural growth's costs rather than its benefits.[10] The evidence indicates that two important sources of environmental costs associated with agricultural activities are the chemical and organic contamination of water and the aggravated scarcity of freshwater due to growing demand by farmers. Although there is no comparable evidence for the Latin American and Caribbean region, analyses for developed countries find that the farm sector's environmental costs vary between 5 and 10 percent of agriculture's GDP, water-related costs being of greater significance than those associated with soil erosion.[11]

In the Latin American and Caribbean region, there is a concern regarding the interaction between the environment, poverty, and property rights. With well-defined property rights, increasing farming incentives generally leads to improved management of those productive assets, such as land and water, important factors of production in agriculture (López 2002). Poorer rural households, however, tend to be much more affected by failures in credit, land, and labor markets than commercial farmers, and so their ability to invest in their productive assets may be diminished. Most notably, poorly functioning credit markets would constrain poorer households, even if they have potential investments that yield high rates of return, and the constraint would be more significant for long-run than for short-term investments. Given that investments in natural assets tend to have longer maturity periods, an increase in farm production profitability would induce fewer investments among poor farmers as compared with richer farmers.

But indirectly, by permitting higher savings and lessening the importance of credit from beyond the farm household, higher incomes associated with agricultural growth would allow more investments in natural resource assets. For the extremely poor, their small endowments of all assets, natural and otherwise, may yield incomes that barely cover their minimum subsistence requirements. In some circumstances, they gradually "consume" their assets or migrate into vulnerable frontier areas as part of a survival strategy. The improvements in welfare of the extremely poor, through increasing their returns to farming and stimulating employment in agriculture and other rural activities, could therefore lead to reduced pressures on the environment.

The contribution of the RNR sector's growth to rural poverty reduction then indirectly reduces farming's environmental impacts. And because the incomes of poor farmers are typically more dependent on environmental resources than the

income of wealthier farmers (Dasgupta 1993), an improvement in the quality of those resources would contribute to poverty alleviation. As a consequence, although the direct evidence is sparse, there is almost certainly a synergy between the environmental and poverty dividends of agricultural growth.

Another important dimension with respect to the environmental consequences of rural sector growth is the composition of activities, especially the mix of technologies and input use in farming. Of particular interest is the interaction between environmental impacts and the orientation of agricultural toward greater integration in world markets. Latin America and the Caribbean became more integrated into the global economy partly as a result of policy reforms implemented during the past two decades, and trade will receive continued attention with regard to environmental outcomes in the context of international negotiations that cover environmental and food-safety standards.

In any case, it is clear that there are numerous reasons to question the conventional wisdom that fears that RNR sector development might come at the expense of the environment. More generally, the main issue that has been ignored by conventional wisdom is that RNR growth could have less environmental consequences than other economic activities. The following section explores the empirical relationship between RNR and other activities and various types of environmental outcomes.

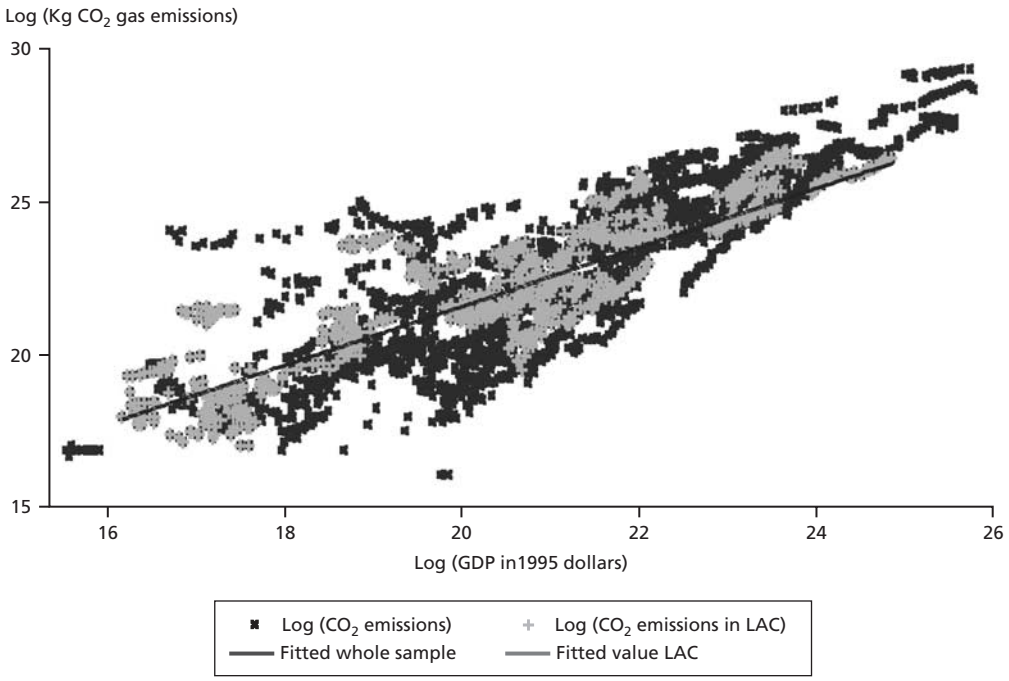
International evidence

This section explores the determinants of three environmental outcomes: carbon dioxide (CO_2) emissions, freshwater withdrawals, and deforestation. The analyses explain the evolution of these variables by the output of five economic sectors that account for total GDP: agriculture; food, beverages, and tobacco; manufacturing; services; and other industries. The data on sectoral output, CO_2 emissions, and water withdrawals were obtained from the *World Development Indicators 2004.* Forest area data are from FAO. The air pollution data covers 1970–2000, the freshwater data is from the year 2000, and the forest coverage data is from two years, 1990 and 2000.

Figure 3.6 shows how the air pollution data relates to RNR GDP data across countries during 1970–2000. The

FIGURE 3.6

CO_2 emissions and RNR activities around the world, 1971–2000



Source: World Bank 2003a.
Note: LAC = Latin America and the Caribbean.

lines in the graph depict an average positive relationship between these two variables for Latin American and Caribbean countries and for the rest of the world. However, this simple illustration can be quite misleading, because it could be capturing international differences, rather than variations over time for each country. The graph could also be misleading since RNR GDP is correlated with other economic activities. Consequently, the positive relationship found in figure 3.6 could be spurious and uninformative for policy discussions.

Table 3.7 reports results from econometric analysis that Bravo-Ortega and Lederman (2005) conducted on the sectoral determinants of CO_2 emissions. The underlying econometric models assumed that each country had a given average level of economic activity and air pollution, thus examining the effects of the various sectors on air pollution for each country over time. In addition, the analysis assumed that air pollution did not affect sectoral outputs. In technical language, the estimates were derived from fixed-effects (FE) models, where each sector's contemporaneous levels explain the extent of air pollution. The researchers, however, did allow for the possibility that air pollution might behave differently across regions of the world. Reported at the bottom of the table are the probability values of the F-test of the significance of the coefficients associated with Latin America and the Caribbean for the five economic sectors. Regression (1) examines the contribution of agriculture and non-agriculture to CO_2 emissions; regression (2) does so for the five economic sectors; and (3) excludes food. Regression (1) shows that the main determinant of CO_2 emissions in all countries is the non-agricultural sector. Latin America and the Caribbean's non-agricultural sector contributes more air pollution than in other developing and high-income countries.

Model (2) indicates that manufactures have the highest coefficient in all countries, but in Latin America and the Caribbean this effect appears to be higher than in the rest of the sample. The food industries seem to reduce the air-polluting effects of manufactures in all countries. Agriculture has a positive impact in poor and high-income countries, but this effect is negative in Latin America and the Caribbean, which suggests that increasing the size of agriculture in Latin America and the Caribbean is associated with lower air pollution levels. When the food industries are excluded, as in model (3), developing countries' RNR's positive coefficient increases in magnitude. It becomes positive for Latin American and Caribbean countries, but the F-test of Latin American and the Caribbean's RNR suggests that this effect is not different from zero. In contrast, the impact of manufactures (which include the food industries) becomes smaller in all countries. These results suggest an interesting relationship between the food industries and air pollution: this sector tends to pollute less than other manufacturing industries, but more than commodity agriculture.

The analysis thus far, however, relies on data from CO_2 emissions from the use of fossil fuels. This means that the available data does not include greenhouse gas emissions caused by the agricultural frontier's expansion into areas covered by natural forests (see section below on deforestation), which is usually associated with the slash and burning of forest trees that produces significant greenhouse emissions. In fact, a small component of Latin America and the Caribbean agriculture is probably responsible for most of the region's contribution to greenhouse gas emissions and indeed accounts for a significant portion of global emissions. According to the World Resources Institute's Climate Analysis Indicators,[12] Latin American and Caribbean land use change, which is largely attributable to agriculturally-driven deforestation in a handful of countries, contributed 643 million tons of carbon-equivalent (MtC) of greenhouse gases in 2000 alone. This was 81 percent greater than the region's total emissions from fossil fuel combustion and cement production. In addition, cattle raising was responsible for a significant proportion of the region's 218 MtC methane emissions. Thus, while Latin American and Caribbean contributed about 5 percent of the world's greenhouse emissions from fossil fuels, it accounts for about 12 percent of global emissions of all greenhouse gas. Still, it is important to keep in mind that agriculture-related emissions are not characteristic of agriculture in general, but are closely tied to particular land use practices.

Another aspect of environmental quality is related to the availability and use of scarce freshwater resources. Figure 3.7 illustrates the relationship between agricultural (RNR) GDP and freshwater withdrawals around the globe in the year 2000. Again, this picture, which shows a positive relationship between these variables, could be misleading and inappropriate for informing policy. Table 3.7 focuses on the sectoral determinants of freshwater withdrawals in a more rigorous empirical framework.

TABLE 3.7

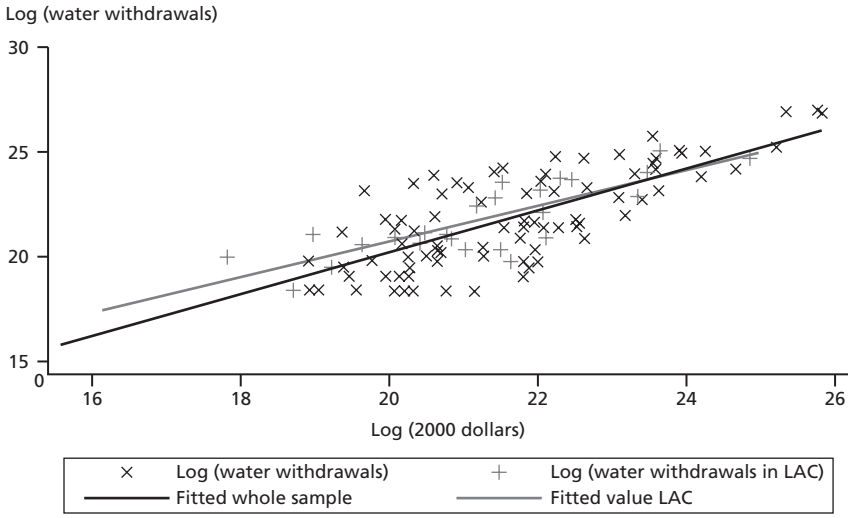
Sectorial determinants of (log) CO_2 emissions: Fixed-effects estimations with annual data, 1970–2000

	(1)	(2)	(3)
Agriculture	0.3797	0.2537	0.3238
	(0.0330)***	(0.0527)***	(0.0396)***
Non-agriculture	0.7354		
	(0.0209)***		
Agriculture times LAC countries	–0.3812	–0.5574	–0.2613
	(0.0695)***	(0.0924)***	(0.0722)***
Non-agriculture times LAC countries	0.309		
	(0.0497)***		
Agriculture times high-income countries	–0.31	–0.1279	–0.2611
	(0.0597)***	–0.0842	(0.0777)***
Non-agriculture times high-income countries	–0.364		
	(0.0484)***		
Manufactures		0.3129	0.1139
		(0.0432)***	(0.0300)***
Food, beverages, and tobacco		–0.0931	
		(0.0333)***	
Other industries	0.1679	0.2389	
		(0.0213)***	(0.0209)***
Services		0.393	0.4486
		(0.0459)***	(0.0389)***
Manufactures times LAC countries		0.4842	0.23
		(0.0906)***	(0.055)***
Food, beverages, and tobacco times LAC countries		–0.0479	
		–0.071	
Other industries times LAC countries		–0.1011	–0.082
		(0.0453)**	(0.0348)**
Services times LAC countries		0.1559	0.0764
		(0.0611)***	–0.0566
Manufactures times high-income countries		–0.1436	–0.2306
		–0.1436	(0.1027)**
Food, beverages, and tobacco times high-income countries		–0.185	
		(0.098)*	
Other industries times high-income countries		–0.11	–0.1871
		(0.0464)**	(0.0574)***
Services times high-income countries		0.048	0.0811
		–0.1484	–0.1364
Observations	3949	1709	3208
Countries	167	111	159
R-squared	0.55	0.72	0.6
LAC effects p-values			
Agriculture	0.98	0.00	0.30
Non-agriculture	0.00		
Food, beverages, and tobacco		0.03	
Manufactures		0.00	0.00
Other industries		0.10	0.00
Services		0.00	0.00
High-income effects p-values			
Agriculture	0.16		
Non-agriculture	0.00		

Source: Bravo-Ortega and Lederman 2005, table 5a.
Note: Standard errors in parentheses; * = significant at 10 percent; ** = significant at 5 percent; *** = significant at 1 percent. LAC = Latin America and the Caribbean.

FIGURE 3.7

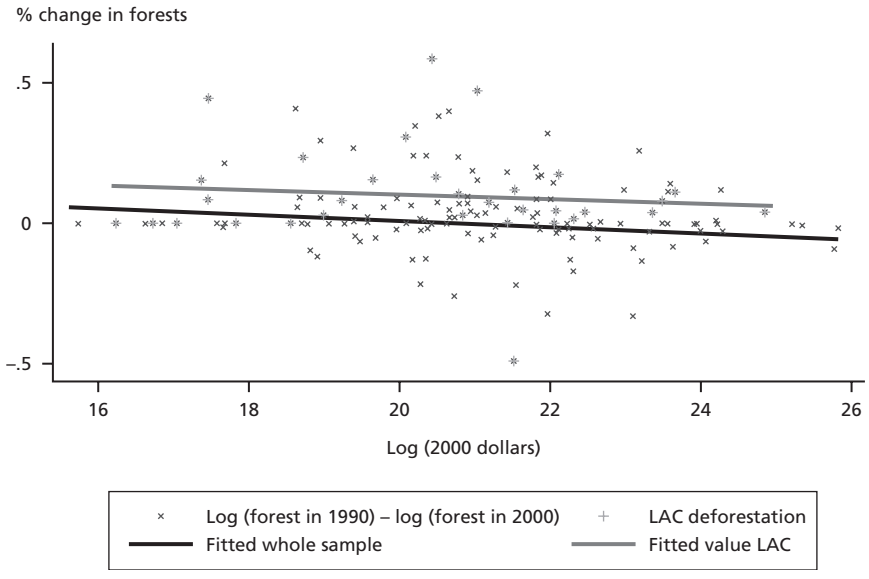
Freshwater withdrawals and RNR activities around the world, 2000



Source: World Bank 2003a.
Note: LAC = Latin America and the Caribbean.

FIGURE 3.8

Deforestation and RNR activities around the world, 2000



Source: World Bank 2003a.
Note: LAC = Latin America and the Caribbean.

Model (1) was estimated with a cross-section of countries (that is, without considering the overtime variation of the explanatory variables), whereas model (2) uses instrumental variables to control for the endogeneity of the sectoral GDPs. The latter specification shows no significant difference between sectors as a pollution source (withdrawals) in developing countries. In Latin America and the Caribbean and high-income countries, the agricultural sector might be a significantly greater source of freshwater withdrawals than the non-agricultural sector. This conclusion is based on the implicit regional coefficients whose F-test are reported at the bottom of table 3.8.

Figure 3.9 shows the correlation between the extent of deforestation across countries between 1990 and 2000 and the size of the RNR sector in a large sample of countries. Although this picture shows that the relationship is quite weak, it might also be deceptive for the reasons mentioned above in reference to the graphs on the other environmental outcomes. Table 3.9 studies more rigorously the sectoral determinants of deforestation.

The regression coefficients under column (1) are from a cross-section of countries, whereas column (2) contains results from an instrumental-variables specification. The latter model's coefficients are all smaller in absolute value than those derived from model (1), which presumes that sectoral GDPs are exogenous. Also, the Hansen test of the validity of the instruments suggests that the chosen instrumental variables are valid. The main finding is that the RNR sector is the principal source of deforestation. However, this coefficient is not significant for Latin America and the Caribbean or for the high-income countries, which implies that this result is driven by the experiences of non-Latin American and Caribbean developing countries.[13]

One reason why the RNR sector as whole might not have a statistically significant impact on Latin American and Caribbean deforestation on average is that this sector includes various activities, some of which might in fact reduce the extent of forest areas. Indeed, the sector includes forestry activities, which are characterized by forest farming activities that might even induce increases in forest lands due to sustainable forest management practices. Another reason is that the expansion of the agricultural frontier in Latin America and the Caribbean countries might actually produce very small gains in the value of RNR GDP, as frontier settlements might produce agricultural commodities very inefficiently. This would lead to insignificant partial correlations between RNR GDP and deforestation. To investigate further how the RNR sector's composition in Latin American and Caribbean countries affects forest lands, the following subsection examines recent Latin American and Caribbean trends in deforestation and land use.

TABLE 3.8

Sectorial determinants of (log) freshwater withdrawals (GMM cross-section estimations with year 2000 data)

	(1) CS	(2) CS IV
Agriculture	0.7122	0.6574
	(0.2155)***	(0.2708)**
Non-agriculture	0.4067	0.6471
	(0.1889)**	(0.2430)***
Agriculture times LAC	–0.1968	0.7465
	(0.426)	(0.569)
Non-agriculture times LAC	0.1819	–0.6754
	(0.387)	(0.524)
Agriculture times high-income	0.2501	0.9978
	(0.311)	(0.4706)**
Non-agriculture times high-income	–0.2737	–0.9527
	(0.280)	(0.4237)**
Observations	95	95
Hansen J-statistic p-value		0.27
LAC effect p-values		
Agriculture	0.18	0.00
Non-agriculture	0.08	0.95
High-income effect p-values		
Agriculture effect	0.00	0.00
Non-agriculture	0.52	0.35

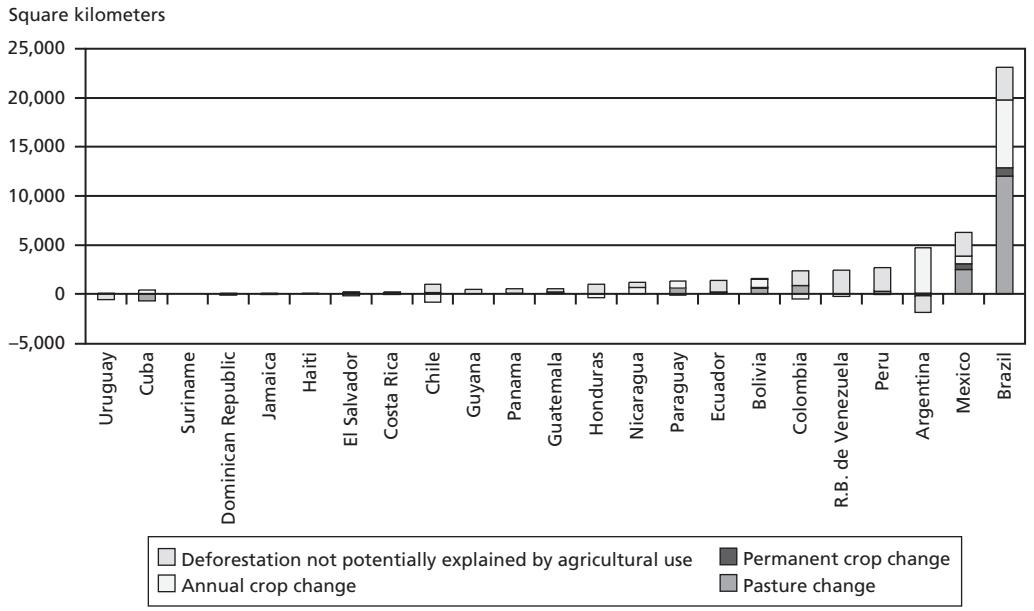
Source: Bravo-Ortega and Lederman 2005.
Note: Robust standard errors appear in parentheses. * = significant at 10 percent; ** = significant at 5 percent; *** = significant at 1 percent; CS = cross-sectional regression; CS IV = cross-sectional regressions with instrumental variables. The IVs are lagged differences of the log sectoral GDPs.

Land use in RNR activities and deforestation in Latin America and the Caribbean countries[14]

Figure 3.9 shows how changes in agricultural land use account for forest loss in Latin American and Caribbean countries between 1990 and 2000. FAO defined total agricultural area as the sum of area in pasture, permanent crops,

FIGURE 3.9

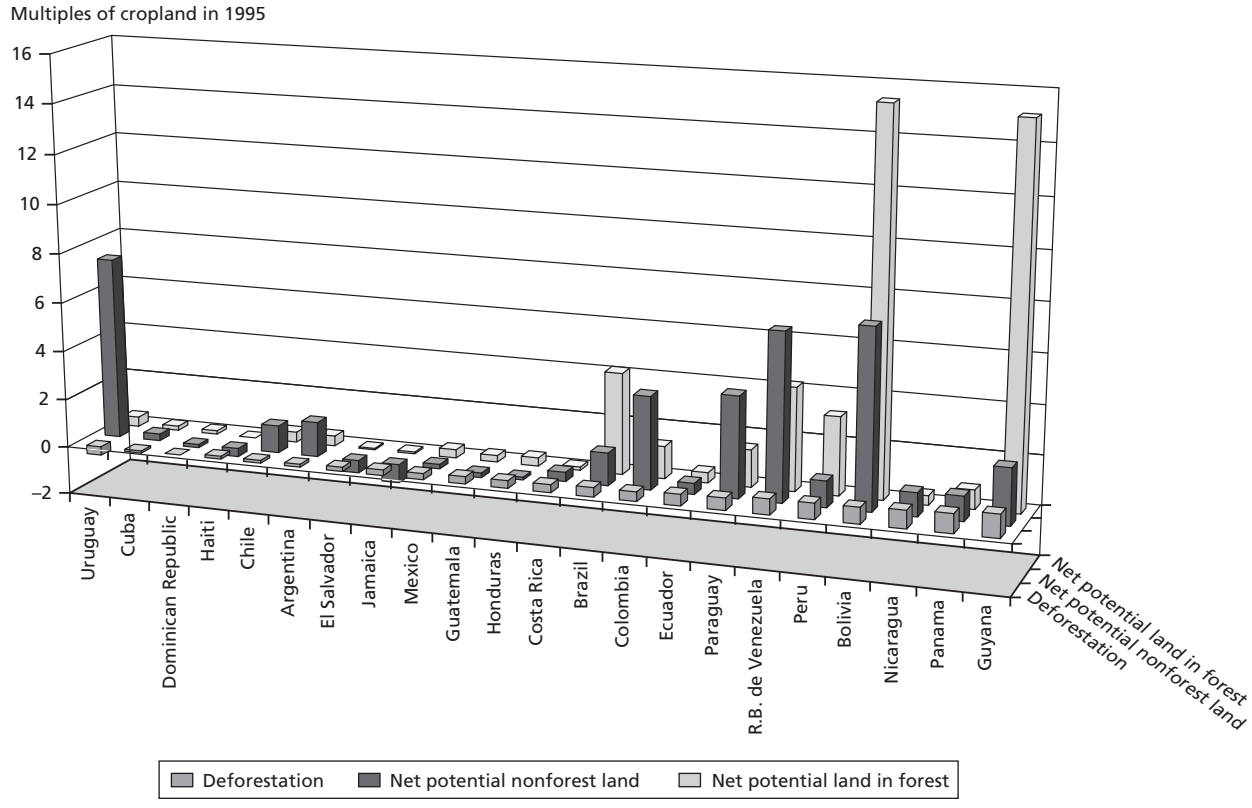
RNR activities and deforestation sources in Latin American and Caribbean countries between 1990 and 2000



Source: Calculations by Robert Schneider, based on FAO data.

FIGURE 3.10

Deforestation and potential agricultural lands in Latin American and Caribbean countries, 2000



Source: Calculations by Robert Schneider, based on FAO data.

TABLE 3.9

Sectorial determinants of deforestation between 1990 and 2000 (GMM cross-sectional estimates)

	(1) CS	(2) CS IV
Agriculture	0.0511	0.0436
	(0.0144)***	(0.0190)**
Non-agriculture	–0.0612	–0.0451
	(0.0142)***	(0.0176)**
Agriculture times LAC	0.0182	–0.0392
	(0.04)	(0.05)
Non-agriculture times LAC	–0.0136	0.0372
	(0.04)	(0.05)
Agriculture times high-income	–0.0801	–0.062
	(0.0257)***	(0.0283)**
Non-agriculture times high-income	0.0707	0.0533
	(0.0225)***	(0.0249)**
Observations	114	114
Hansen's J-statistic p-value		0.48
LAC effects p-values		
Agriculture	0.07	0.92
Non-agriculture	0.04	0.87

Source: Bravo-Ortega and Lederman 2005, table 5.
Note: Robust standard errors appear in parentheses. ** = significant at 5 percent; *** = significant at 1 percent. CS = cross-sectional regression; CS IV = cross-sectional regression with instrumental variables. The IVs are the lagged differences of the (log) sectorial GDPs. LAC = Latin America and the Caribbean.

and annual crops.[15] In figure 3.9, deforestation is represented as the sum of these changes in the *or* FAO-reported areas in pasture, permanent crops, annual crops, and "unexplained." That is, this latter category is constructed as the difference between the sum of agricultural land-use changes and deforestation. [16] Where this difference is positive, deforestation exceeds reported increases in agricultural uses over the decade. Where it is negative, the change in agricultural land use exceeds deforestation.

In Brazil, for example, 33,000 square kilometers of deforestation (14 percent of the total over the period) cannot be explained by increases in agricultural uses. The increase of agricultural land in Argentina, on the other hand, was nearly 60 percent greater than deforestation was over the period, suggesting that some 16,000 square kilometers of new *nonforested* land was brought into agricultural use.

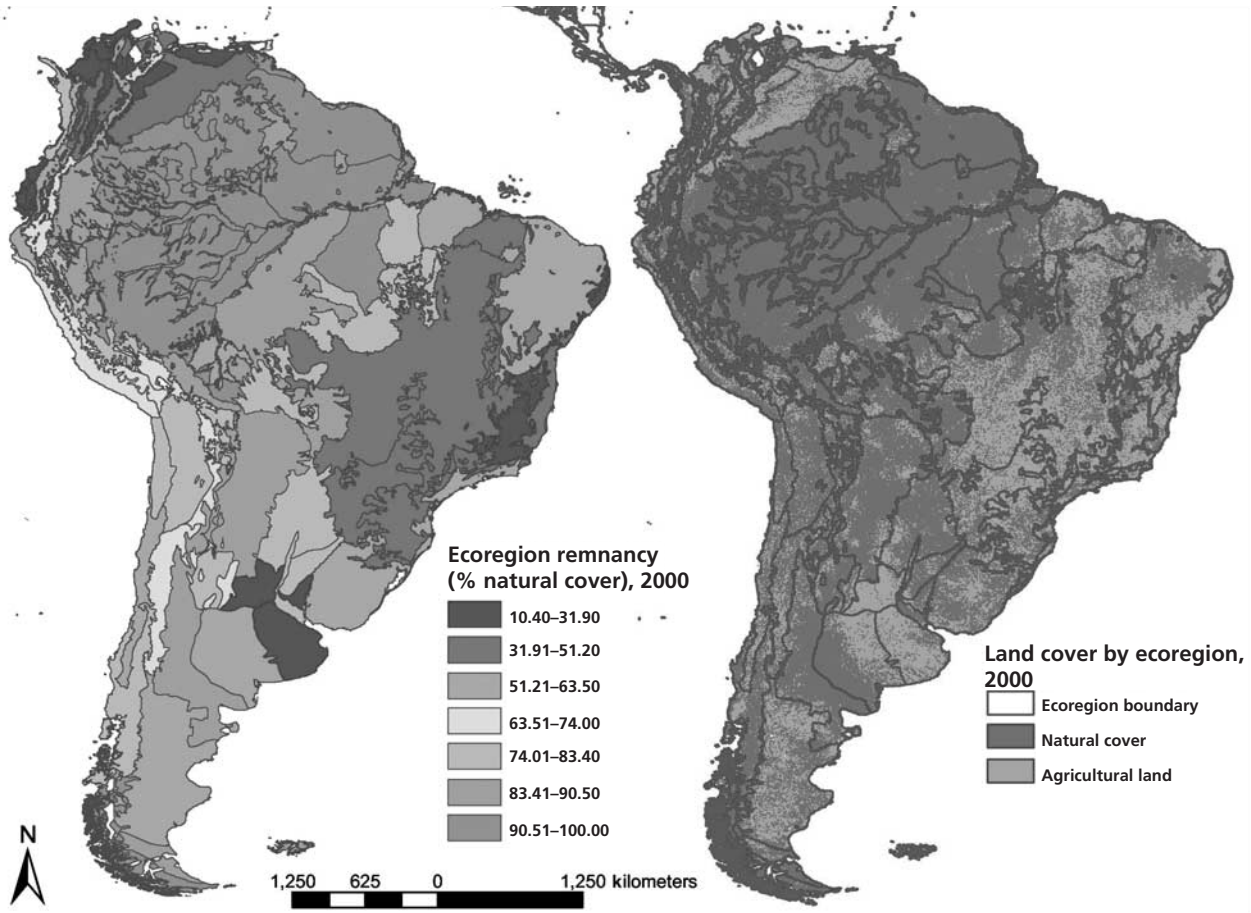
Two conclusions can be drawn from figure 3.10. First, Amazonian countries dominate total Latin American and Caribbean deforestation. These countries accounted for 70 percent of total deforestation, with Brazil alone accounting for half of total Latin American and Caribbean deforestation over the period. Second, crops account for a minor part of total deforestation. Of total Latin American and Caribbean deforestation of 460,000 km^2 during the period, only one-third (155,000 km^2) can be explained by increases in cropped land.[17] The remaining 305,000 km^2 can be accounted for by the sum of the reported increases in pasture (35 percent of the total) and the residual "unexplained" category (31 percent of the total). FAO notes that "the dividing line between (permanent pasture) and the category 'Forests and Woodland' is indefinite, especially in the case of shrubs, savannah, etc., which may have been reported under either of these two categories" (FAOSTAT). We conclude that with the exception of reclassification into urban areas, nearly the entire nonurban portion of this "unexplained" deforestation is likely to be in pasture (at a low stocking density), thus creating confusion between the classifications of open woodlands and permanent pasture.[18] If this is the case, some two-thirds of new deforestation went into pasture: at least 35 percent of new forest frontier land went unambiguously into pasture, plus an additional 30 percent of "unexplained" deforestation that reflects new pasture formation at low stocking rates.[19] This conclusion is reinforced by agricultural census data (1997) for the Brazilian Amazon, which indicate that 80 percent of agricultural land use is pasture, with another 10 percent of agricultural land either in long fallow or abandoned (Chomitz and Thomas 2003).

To what extent is deforestation due to scarcity of additional cropland outside of forests? Figure 3.10 compares deforestation with estimates of potential additional cropland within and outside of forests. These estimates are based on the FAO deforestation data described above, and the International Institute for Applied Systems Analysis (IIASA) estimate of land with potential for cereals production—both within and outside of forest lands. To obtain a measure of potential *additional* land that could be put into crops outside of forests, we have subtracted land in crops (1995) from IIASA's estimate of land outside forests with cereals potential.[20] All three values, deforestation, potential additional land outside forests, and potential additional land within forests are expressed as a multiple of cropland in 1995.

Three major conclusions emerge from figure 3.10. First, the amount of land in crops is a much better predictor of a

FIGURE 3.11

The ecological footprints of South American agriculture, 2000



Source: Compiled by Rodrigo Sierra (University of Texas at Austin).

country's deforestation than is either the availability of additional potential cropland outside of forests or potential cropland within forests. The wide variation in deforestation largely reflects variation in the size of countries' agricultural sectors. When expressed as a multiple of cropland, cross-country variation falls dramatically, from -0.4 for Uruguay (forest cover expanded by 0.4 of 1995 cropland), to 1.0 for Guyana (1990–2000 deforestation was equal to land in crops). The leaders in area deforested, Brazil and Mexico, lost forests equal to approximately 0.4 and 0.2 times their cropland areas, respectively, over the decade.

Second, deforestation is not due to a lack of additional potential cropland outside of forests. The 11 Latin American and Caribbean countries with the highest deforestation rates relative to existing cropland (frontier expansion) all have significant expanses of unexploited land with cereals potential outside forests. Both Bolivia and Repûblica Bolivariana de Venezuela have approximately seven times existing cropland still available in nonforest lands. Colombia has nearly four, Guyana over two, and Brazil, Nicaragua, Panama, and Peru, all have approximately one. Only five countries—the Dominican Republic, El Salvador, Guatemala, Haiti, and Honduras—appear not to have additional nonforest land with cereals potential.

Third, the 10 countries with the highest frontier expansion rate also harbor large expanses of cereals-quality land under forest cover. Especially noteworthy in terms of potential cropland under forest cover are Guyana and Bolivia where forest land with cereals potential exceeds land currently in crops by a factor of 15 and R.B. de Venezuela and Brazil where the factor exceeds 4.

In sum, figures 3.9 and 3.10 draw our attention to the following trends observed in Latin American and Caribbean countries: (1) the dominant role that pasture plays in new frontier expansion; (2) the large number of countries where relatively good agricultural land, both outside of the forest and under forest cover, creates an incentive for continued frontier expansion; and (3) the relatively close relationship between the size of the existing area of cropland and the overall levels of new deforestation. This latter observation is not surprising, but as mentioned in the introduction to this chapter, even small changes in forest coverage area can have severe consequences for biodiversity maintenance. This is the subject of the following section.

RNR activities and biodiversity

The downstream environmental impacts of the expansion of the agricultural frontier and deforestation can be traced to coral reefs and aquatic wildlife, usually through water pollution. Here we examine the environmental impact associated with the demand by Latin American and Caribbean's agricultural sector on environmental stockflow and service-fund resources. There is abundant research showing that growth in agricultural land results in a net loss of ecosystem services and biodiversity. For example, the creation of agricultural land results in a net release of CO_2 into the atmosphere equivalent to the loss of the carbon sequestration services of natural vegetation; a loss that in fact, is shared globally. Evidence from Costa Rica shows that total biomass and agricultural land are negatively correlated (Grau et al. 2004). Similarly, the biodiversity loss associated with agricultural expansion has been well documented, including the loss of domesticated, often traditional, crop varieties. For example, Pearman (1997) and Bojsen and Barriga (2002) show that declines of frog and fish diversity, respectively, in Ecuador are associated with agricultural lands. This relationship has also been observed in other regions for many other species. Schulze et al. (2004), for example, show that the number of species in several plant and animal groups drops with the transformation level of local environments. Indeed, globally, habitat loss is the most important cause of biodiversity loss (Henle et al. 2004) and, historically, the most important cause of habitat loss has been agricultural expansion. On the other hand, a growing source of habitat loss in past few decades has been urban growth. In some countries, such as Puerto Rico and Uruguay, agricultural land has declined, while urban areas have grown (FAO 2004; Grau et al. 2004).

From an ecological viewpoint, agricultural land demand has been met by transforming natural ecosystems into agricultural ecosystems. Some of these environmental resources have been incorporated directly into agricultural output (for example, soils) and some indirectly (for example, the loss of biodiversity and ecosystem services). It is difficult to estimate the economic value of this loss because most environmental stockflow and fund-service resources lack markets or they are poorly developed (Daly and Farley 2004). Uncertainty about the nature of the resource is one of the key limitations for valuation. It is estimated that 30 million types of organisms exist worldwide. Of these only 2 million are known to science. Constanza et al. (1997) estimated the average current economic value of 17 ecosystem services for 16 biomes at $33 billion a year. Their estimates put the value of a hectare of tropical forest at $2,007. In contrast, local estimates within Latin America and the Caribbean vary from $1,200 per hectare from tourism in Costa Rica (Tobias and Mendelson 1991) to $18–$47 per hectare from biological goods consumed and sold by local households (Godoy et al. 2002). These estimates contrast with reported economic returns (that is, income) from agricultural activities in similar periods for areas previously covered by tropical forests of approximately $21 per hectare in the northern Ecuadorian Amazon (derived from Marquette 1998) and $40 per hectare in three different sites in the Brazilian Amazon (derived from Browder 2002). Thus the ecological value of natural habitats can outweigh the value of RNR activities in frontier lands.

An approximation of the demand for and the ecological resources by Latin American and Caribbean's agricultural sector is carried out here for continental South America. This measure gives an idea of the proportion consumed directly and indirectly and the balance of ecological resources available. It also provides a relative measure of the risk of biodiversity or ecosystem service loss that should be imputed to the region's agricultural sector. To do this, we compare the distribution of agricultural lands across and in proportion to the distribution of geographic biodiversity units in continental South America. For this region, relatively reliable maps of both eco-regional diversity and land use (Eva et al. 2002) exist at scales that are consistent with continental level analysis and between datasets (that is, 1 km resolution). Eco-regions are relatively large geographic units with a distinctive assemblage of species, natural communities, and environmental conditions (World Wildlife Fund 1999). Changes in area covered by natural ecosystems in an eco-region due to the expansion of agricultural land

offer a relatively detailed measure of the ecological footprint of continental South America's agricultural sector above and beyond the aggregate measures offered above for Latin America and the Caribbean as a whole.

In total, there are 120 eco-regional units in continental South America. On average, 31.6 percent of the area of each eco-region has been transformed to agriculture with a significant variation. Some eco-regions have been almost completely converted to agricultural uses and hence have potentially experienced proportional losses in biodiversity and ecosystem services. The Sinú Valley Dry Forest and the Pernambuco coastal forests eco-regions, for example, have lost almost 90 percent of its original area. Table 3.10 shows the eco-regions with area losses greater than 50 percent of the original and distribution by country. In these regions, the environmental impact of agricultural is high. Figure 3.11 illustrates the region's intervention level.

Interestingly, Sierra (2005) shows that eco-regions affected by economic transformation also tend to lack environmental conservation areas, such as national parks. This is in part due to the difficulty of establishing reserves in areas that offer significant agricultural value. It is also interesting to note that no eco-region found partially or totally in Peru, Suriname, or Uruguay has been transformed more than 50 percent. This suggests that the agricultural sector in these countries has a smaller ecological impact than in most other countries in the region. Path dependency in land use in forest frontiers is further studied in chapter 4 of this report. In any case, historical patterns of frontier settlement have resulted often in increased accessibility and greater market development, which have favored agricultural growth, some of which has been met by expanding the area under agriculture. In turn, agricultural growth patterns are affected by local resource endowments, such as soils and commercial species, which are directly associated with specific geographic biological units; represented here by eco-regions. This determines that some units, those with best agricultural potential, are developed more intensively than those with lower overall potential. In addition, certain types of agricultural growth follow reductions in transport costs (that is, follow roads) and select better soils (Kaimowitz and Angelsen 1998).

Overall, the international evidence from past decades suggests that RNR GDP in Latin America and the Caribbean is greener than in other developing countries, and it is greener than its non-RNR counterparts in certain aspects. In the case of deforestation, on average Latin American and Caribbean RNR activities have not had noticeable impacts on overall forest land, but there is much heterogeneity both across countries and across types of RNR activities within countries. The data suggest that livestock activities associated with land expansion dedicated to pasture tends to have the most noticeable impacts on deforestation in Latin American and Caribbean countries. Nevertheless, as with all international evidence based on a large sample of countries, it is difficult to conclude that this is the case in all countries of the region. We now turn our attention to evidence of agro-chemical use in Chile and Mexico.

Case study evidence on the use of agricultural chemicals

The ROA study for Chile included an analysis of the changes in agricultural cropping patterns over the past two decades towards higher-valued products with an export orientation. One conclusion that can be derived from the study is that there is an interaction between environmental impacts and the orientation of agriculture toward greater integration in world markets as a result of policy reforms beginning in the mid-1970s. With the increased profitability of farming, especially the export sector, land values have risen and with them the incentive to invest in more environmentally-friendly practices. Furthermore, the trade orientation of many Chilean farmers has exposed them to the demands of buyers and consumers in export markets, especially those of richer countries, making them more aware of the production process, not merely the quantities and prices of harvested crops. This has been especially true with respect to perishables.

A greater emphasis in the aggregate toward export-oriented crops compared to import-competing cereals, such as wheat, has also led to a shift in the input mix. This change in input use patterns, brought about by the altered composition of production, has important consequences especially for the discharge of chemical pollutants associated with pesticide and fertilizer use. The ROA Chile study took an econometric approach to ascertaining how the change in the sector's orientation since the late 1970s toward a more open economy influenced the levels and types of agro-chemicals consumed in farm production. The response of agro-chemical input demands to structural changes in both the mix of agricultural output and the scale of production was estimated using annual data for the 1980–2000 period derived from national statistics on export-oriented and traditional crop production and agro-chemical use measures. The study involved analyzing the response of input demands, controlling for factor-price induced changes in chemical use, placing emphasis on

TABLE 3.10

Impact of agricultural land on eco-regional integrity in Latin America and the Caribbean

	Country												Eco-region cover characteristics 2000			
Eco-region	Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Fr. Guiana	Guyana	Paraguay	Peru	Suriname	Uruguay	Venezuela, R.B. de	Total (original) area km^2	Natural cover/ extractive land uses km^2	Agricult land km^2	% remnant (natural)
Sinú Valley dry forests					X									25646.1	2674.6	22971.5	10.4
Pernambuco coastal forests			X											17972.3	1937.2	16035.1	10.8
Argentine Espinal	X													129230.5	18684.7	110545.8	14.5
Pernambuco interior forests			X											23234.0	3974.4	19259.6	17.1
Guajira-Barranquilla xeric scrub					X								X	32532.6	6624.0	25908.6	20.4
Ecuadorian dry forests						X								21521.8	4811.8	16710.0	22.4
Apure-Villavicencio dry forests					X								X	69802.0	15735.1	54066.9	22.5
Manabi mangroves						X								1162.3	312.5	849.9	26.9
Catatumbo moist forests					X								X	23359.0	6511.5	16847.5	27.9
Western Ecuador moist forests					X	X								34444.8	9973.5	24471.3	29.0
Magdalena-Urabá moist forests					X									78425.7	22921.5	55504.1	29.2
Magdalena Valley dry forests					X									19884.5	6099.1	13785.4	30.7
La Costa xeric shrublands													X	70239.4	21584.2	48655.2	30.7
Bahia interior forests			X											245038.1	75513.6	169524.5	30.8
Humid Pampas	X													298817.5	93498.4	205319.1	31.3
Guayaquil flooded grasslands						X								2974.6	949.9	2024.7	31.9
Lara-Falcón dry forests													X	17447.4	6074.1	11373.3	34.8
Llanos					X								X	396102.8	140103.9	255998.9	35.4
Alta Paraná Atlantic forests	X		X						X					534019.5	190708.8	343310.8	35.7
Cauca Valley dry forests					X									7448.9	2699.6	4749.3	36.2
Patia Valley dry forests					X									2299.7	849.9	1449.8	37.0
Atlantic dry forests			X											119257.0	45893.1	73363.9	38.5
Rio Piranhas mangroves			X											2149.7	887.4	1262.3	41.3
Bahia coastal forests			X											115882.5	48080.3	67802.3	41.5
Northeastern Brazil restingas			X											10173.5	4249.4	5924.1	41.8
Maracaibo dry forests													X	31032.8	13048.0	17984.8	42.0
Maranhao Babaçu forests			X											144228.3	62628.1	81600.2	43.4
Magdalena Valley montane forests					X									106771.4	47555.3	59216.1	44.5
Northern Andean paramo					X	X							X	30295.4	13897.9	16397.5	45.9
Cauca Valley montane forests					X									32545.1	15285.2	17259.9	47.0
Cerrado			X											2012396.8	978265.1	1034131.7	48.6
Campos Rupestres montane savanna			X											28258.2	14010.4	14247.9	49.6
Total subcontinent														18284945.2	12696087.2	5252121.2	69.4

Source: Rodrigo Sierra (University of Texas–Austin) based on data from Eva et al. (2002).
Note: Only eco-regions with a loss greater than or equal to 50 percent are shown.

TABLE 3.11

Differences in agro-chemical demands between export-oriented and traditional crops in Chile (price and output demand elasticities for imported fertilizers, pesticides, and domestic nitrate fertilizers)

	Farm wages	Imported fertilizers	Pesticide prices	Domestic prices	Exportable output	Nonexportable agricultural	Annual autonomous change
Imported fertilizers	–0.035	–0.136	0.240	–0.128	0.838	0.677	–0.066
Pesticides	–0.036	0.173	–0.939	0.849	0.256	1.016	–0.042
Domestic nitrates	0.151	–0.134	0.539	–0.584	–0.039	0.56	0.02

Sources: López and Anríquez 2003; FAO's ROA project.

the following question: Is agricultural growth in Chile inherently chemical-intensive or is the fast growth of chemical use in the 1990s largely explained by input price changes?

One important conclusion of the analysis is that this increase is principally due to price effects rather than overall output expansion effects. Changes in output scale explain less than one-quarter of the total increase of pesticides and nitrates. The overall effect of output expansion has been low as a consequence of the changes in the composition of Chilean crops, from import-competing towards export-oriented crops. The negative environmental externalities of the export-oriented sector have been less, as is indicated by the input demand elasticities with respect to output changes in both export and import-competing sectors (see table 3.11). In the case of fertilizers, pesticides, and other agro-chemicals, while chemical use and the chemical intensity per unit of total agricultural GDP has increased, the increases are less than they would have been in the case of a similar expansion led by import-competing (traditional) crops.

To illustrate the last point raised in the previous paragraph, consider the case of pesticides. The nominal price of pesticides over the 1990–2000 period increased by 70 percent, compared with 300 percent increases for the nominal wage rates and increases on the order of 130 percent for fertilizers and other inputs. That is, pesticides became relatively much cheaper than other inputs over the decade. Given the estimated high price elasticity of pesticide demand (see table 3.11), these relative price changes explain almost 70 percent of the increased pesticide use over the decade. By contrast, the role of increased agricultural output on pesticide demand is more modest, although pesticide demand appears highly responsive to increases in traditional agricultural output.

Simulating a *neutral* expansion in agricultural output (that is, where both export and traditional output grow at the same rate) shows a rapid expansion in the use of pesticides by total agriculture. Traditional agriculture producing import-competing crops is more dependent on pesticide use than is export-oriented agriculture. A neutral expansion of agriculture of 4 percent (which has been about the sector's annual growth rate over the last three years), is likely to increase agricultural pesticide use by about 2.8 percent (an elasticity of pesticide use with respect to aggregate agricultural output of the order of 0.7). A change in the production composition in favor of the exportable sector would cause a reduction of pesticide consumption. Between 1990 and 2000, agricultural exportables expanded twice as fast as traditional outputs. Given the econometric results, had both sectors expanded at the same rate (keeping the total rate constant), pesticide use would have risen by 130 percent instead of by an observed 100 percent. Only three-fifths of the observed increase in pesticide use can be attributable to export crops, because the export sector grew twice as fast.

The rise in the pesticide intensity of agriculture is worrisome because it has negative health and environmental consequences. The high price-responsiveness of pesticide demand is, however, an indication that the pesticide/output intensity potentially can be reduced through price policies. Although a first-best policy would use instruments that directly control emissions, the use of taxes on inputs that are directly related to emissions may be justified under certain circumstances (especially when monitoring and controlling emissions directly is expensive and/or very difficult). What the econometric analysis for Chile suggests is that given the high responsiveness of pesticide use with respect to pesticide prices, a modest tax on domestic and imported pesticides can be effective in reducing the pesticide/output intensity, thus diminishing one of the

most important negative environmental externalities of agriculture.

The ROA study for Mexico did not provide a quantitative assessment of agricultural growth's impact on the environment, but it did report findings from a variety of sources. The consensus from various studies is that one of Mexico's most pressing environmental problems is the expansion of degraded land in the last decades. By far, the largest category is that of land that suffers soil erosion from water runoff, which affects 37 percent of total land.

Underground water pollution and excessive water extraction of aquifers also represents a problem in almost every state of the Mexican Republic.

Agriculture appears to be mining the natural resource base, and farming practices have to be improved to protect the environment and to reduce their impacts on soil and water.

The main policy implication that can be derived from both the international and the case study evidence is that national trade policies and public expenditures should not discriminate against RNR economic activities based on environmental concerns. Where there is evidence that specific aspects of agricultural production processes are having deleterious environmental consequences, such as the expansion of pasture land in Brazil, water use in Mexico, and pesticide use in Chile, the proper policy response is to target specific taxes or policies to those aspects, rather than discriminate against the whole RNR sector.

3.5 The RNR sector and macroeconomic volatility

It is now well known that Latin American and Caribbean economies have historically faced dramatic swings in macroeconomic performance, often associated with balance of payments or financial crises. We also know that macroeconomic uncertainty has declined since the advent of the economic reforms implemented during the 1990s (De Ferranti et al. 2000). Nevertheless, volatility remains an important obstacle for improving the welfare of Latin America and the Caribbean citizens, and thus the RNR sector's contribution to the region's infamous macroeconomic instability is an important policy issue. This section first discusses the overall contribution of the RNR sector's size to national macroeconomic volatility. In turn, we discuss the factors that can reduce this sector's contribution to macroeconomic uncertainty, which is a fundamental contribution to policy discussions about what can be done to reduce economic uncertainty in the region.

Volatility and co-movement across economic activities[21]

The first issue that arises is whether economic diversification across sectors, beyond the RNR sector, can help reduce economic volatility. For within-RNR-sector diversification to be effective in reducing price or production volatility, it must be the case that RNR-product prices or quantities are not highly and positively correlated with one another. If prices were negatively correlated, risk would be eliminated, and no correlation would allow risk to be reduced through within-sector diversification. A significant positive correlation among RNR commodity prices implies that diversification in this sector will not protect a country from volatility.

To evaluate the extent of co-movement among agricultural prices, we examined the relationship between growth rates of world prices for agricultural commodities from 1957 to 1998. To evaluate co-movement of national production levels, we obtained FAO production quantities for all countries from 1961–2002 (for which there is data). We examined the co-movement of changes in growth rates of these quantities to make the various goods comparable and to cancel out fixed country effects. Finally, to consider co-movement of alternative economic sectors for the economy as a whole, we examined changes in the growth rates of various sectors comprising aggregate GDP.

To evaluate the co-movement of these merchandise bundles, three measures were calculated and are presented in table 3.12. First, we calculated the average of the correlation coefficients for the relevant baskets. Second, we conducted a principal component analysis on the baskets and recorded the proportion of the variance accounted for by the first principal component. This proportion will rise as the basket's co-movement rises. Finally, as the contribution of the first principal component in factor analysis may be sensitive to the number of variables examined, the average of the factor loadings for the first principal component is also reported. The factor loadings represent the amount of weight placed on each variable in the construction of the principal component. As these factor loadings rise, the first principal component explains more of the entire basket variance. Therefore, all three measures presented in table 3.12 measure the amount of the basket's co-movement, with higher values indicating a greater degree of co-movement.

Three observations can be derived from these results. First, on the whole, the data indicate that agricultural prices tend to co-move more than agricultural quantities. This observation does not strictly hold when considering

TABLE 3.12

Co-movement of prices and quantities across economic activities

	Average correlation coefficient	Variation explained by first principal component (%)	Average factor loading for first principal component (%)
Prices			
All agricultural products	0.2065	29.80	50.00
All agricultural products and MUV	0.1673	29.14	49.50
Tropical agriculture	0.1730	32.80	49.10
Animal products	0.2960	47.70	68.50
Cereals, etc.	0.3080	41.04	59.50
Quantity Produced			
World			
All agricultural products	0.1126	21.61	36.30
Tropical agriculture	0.1874	47.40	68.10
Animal products	0.2293	61.50	78.40
Cereals, etc.	0.1789	36.40	51.20
Latin America and the Caribbean			
All agricultural products	0.0724	18.60	29.50
Tropical agriculture	0.2347	49.70	69.70
Animal products	0.1989	59.90	77.40
Cereals, etc.	0.0995	32.40	41.90
Entire Economy			
Five broad economic sectors[a]	–0.0184	26.40	2.50

a. Agriculture; food, beverages, and tobacco; services; other manufactures; and other industry.
Note: MUV = Manufacturer's unit value.

the three broad groupings of agricultural products individually (tropical agriculture, animal products, cereals, and so forth), but differences in the availability of price and quantity data make the corresponding product groups differ in composition, thus making comparisons less reliable across prices and quantities for the groupings. In any case, the observation that prices tend to co-move more than quantities suggests that diversification within agriculture to protect it from price shocks is even less effective than diversification to protect against production shocks.

The second observation is that there is less co-movement of both prices and quantities for the overall agricultural portfolio than within each of the three product groups, consistent with the intuition that prices and production levels for similar goods are more likely to co-move. This is relevant because diversification *across* agricultural groups is likely to be more difficult than diversification *within* groups, due to the similarity of agro-climatic requirements for similar products. Therefore, higher co-movement within agricultural groups suggests that diversification to reduce price and quantity shocks is even more difficult.

The final observation relates to diversification's benefits within agriculture as compared to the benefits between agriculture and other economic activities. Table 3.12 shows the extent of co-movement of five broad product categories: agriculture, downstream agriculture (food, beverages, and tobacco), services, manufactures (other than food, beverages, and tobacco), and industry (other than manufacturing). The relatively low values of the co-movement indicators, particularly for the average correlation coefficient and the average factor loadings, indicate little positive co-movement among these sectors. A similar result is found when including the manufacturing unit value (MUV) index in the agricultural price data, which causes the co-movement measures for the basket to fall. This suggests that diversification from agriculture to downstream agricultural activities and non-agricultural economic activities (such as manufacturing and services) has much more potential for protecting against price and production volatility than diversification within agriculture.

Other researchers have drawn similar conclusions regarding the co-movement of agricultural prices and quantities.

Using prices from 1970 to 1991 for a sample of agricultural commodities, Quiroz and Valdés (1995) found that 22 out of the 28 pairwise correlations between prices were positive and that the correlations appear to be increasing over time. Barghouti et al. (2004) suggests a similar pattern over time for production correlations, due to new crop protection procedures and irrigation innovations, which reduce yield fluctuations for all crops. Using concentration ratios to consider the case of Malawi, Tanzania, and Zimbabwe, Alwang and Siegel (1994) found that "there is no clear relationship between the diversity of agricultural commodity exports, as measured by a lack of concentration, and export earnings stability or export earnings growth. This lack of a clear relationship between export diversity and export performance has been reported in other studies" (Love 1983; MacBeand and Nguyen 1980; Svedberg 1991). On the whole, therefore, agricultural portfolio diversification to protect from price and production volatility appears to be less promising than diversification across a broad set of economic activities beyond the RNR sector itself.

The RNR sector's contribution to macroeconomic volatility[22]

Even if diversification within agriculture might be less effective than general economic diversification in terms of reducing overall national economic risk, it is important to understand how the RNR sector's size itself contributes to national volatility. This is key for informing policies that aim to improve national welfare by stimulating some sectors over others.

This section studies the sectoral determinants of macroeconomic volatility. The relationship between macroeconomic volatility and growth was studied in the seminal paper by Ramey and Ramey (1995), which found that volatility reduces economic growth. In a recent paper, Hnatkovska and Loayza (2003) studied the reverse relationship and found a negative relationship between economic growth and volatility. We expect GDP growth to reduce volatility as long as growth leads to economic diversification, although it is also possible that growth and development more generally are associated with improvements in the regulatory or institutional environment that reduce macro volatility. Nevertheless, the latter effect would not be necessarily associated with a particular sectoral growth pattern. In any case, higher GDP levels are very likely negatively correlated with standard measures of macroeconomic volatility as long as the diversification and institutional-development effects predominate over any specialization effect associated with GDP growth.

The proxy of macroeconomic volatility we use is the standard deviation of the national-GDP growth rate over 10-year periods during 1960–99. In turn, we regress volatility against the decade-average sector GDPs in log levels using FE estimators. Since sectorial GDPs are included in the total GDP data used to calculate GDP-growth volatility, we also instrument the sectorial outputs. Below we report standard FE estimates (with country-specific dummy variables) of the sectorial GDP effects on volatility, as well as FE IV estimates, where the IVs are the lagged-differenced (initial) sectorial GDPs.

Table 3.13 shows the standard deviation of the growth rate of GDP, RNR GDP, and non-RNR GDP, across decades and regions. These data show that agricultural GDP is more volatile than non-agricultural GDP across regions and decades. RNR GDP is most volatile in the case of poor non-Latin American and Caribbean countries, followed by Latin America and the Caribbean and high-income countries. This pattern is closely followed with some exceptions when using total GDP and non-RNR GDP.

Table 3.14 presents, under the first column, the results of the fixed-effects estimations with IVs used to capture the exogenous component of sectorial GDPs. The second column lists the results from a simpler FE estimator. Both sets of results indicate that RNR and non-RNR GDPs reduce volatility in developing countries, including Latin America and the Caribbean. In high-income countries, RNR GDP

TABLE 3.13

Volatility of economic growth across sectors and regions by decades

Decade	1980s	1990s
Standard deviation of annual RNR GDP growth	0.076	0.080
High-income countries	0.071	0.058
LAC countries	0.072	0.052
Other developing countries	0.078	0.092
Standard deviation of annual non-RNR GDP growth	0.046	0.057
High-income countries	0.020	0.019
LAC countries	0.055	0.054
Other developing countries	0.051	0.066
Standard deviation of annual total GDP growth	0.040	0.050
High-income countries	0.021	0.020
Latin American and Caribbean countries	0.046	0.041
Other developing countries	0.044	0.059

Source: Bravo-Ortega and Lederman (2005), based on World Bank data.

TABLE 3.14

Sectorial determinants of GDP growth volatility, 1960–99

	FE IV	FE
RNR	–0.047	–0.032
	(0.013)***	(0.018)*
Non-RNR	–0.019	0.007
	(0.011)*	(0.011)
RNR times LAC countries	0.008	0.017
	(0.011)	(0.016)
Non-RNR times LAC countries	–0.022	–0.022
	(0.011)**	(0.016)
RNR times high-income countries	0.054	0.032
	(0.015)***	(0.020)
Non-RNR times high-income countries	–0.053	–0.032
	(0.014)***	(0.019)
Sargan (p-value)	0.234	—
Observations	101	101
Countries	71	71
F test LAC (p-values)		
RNR	0.00	0.20
Non-RNR	0.00	0.19
F test high-income (p-values)		
RNR	0.08	0.92
Non-RNR	0.00	0.14

Source: Bravo-Ortega and Lederman 2005, table 6.
Note: Dependent variable: standard deviation of total GDP growth by decades. * = significant at 10 percent; ** = significant at 5 percent; *** = significant at 1 percent; — not applicable. LAC = Latin America and the Caribbean.

increases volatility whereas non-agricultural output decreases it. Moreover, the results indicate that the impact of the non-RNR sector in decreasing macroeconomic volatility increases with the level of development since this elasticity is smaller in magnitude for poor non–Latin American and Caribbean countries, followed by Latin American and the Caribbean and high-income countries. The elasticity that captures the RNR impact in macroeconomic volatility follows the opposite pattern: RNR GDP decreases volatility in poor non–Latin American and Caribbean countries and to a lesser extent in Latin American and Caribbean economies.

Recent papers by Imbs and Wacziarg (2003) and Klinger and Lederman (2004) found a consistent evolution of the relationship between economic diversification of production, employment, and exports, and the development level. This pattern follows an inverted U-shape with respect to the development level, whereby economies tend to reach a peak in economic diversification around $9,000–10,000 per capita in purchasing-power parity terms. Our results are consistent with these findings. That is, agricultural growth reduces macroeconomic volatility in Latin America and the Caribbean and other developing countries, where economic growth is associated with economic diversification. The positive effect of RNR GDP on volatility in high-income countries might come from an increase in specialization within the RNR sector. In contrast, the non-RNR sector results might seem puzzling in light of Imbs and Wacziarg (2003), because the volatility-reducing effect of non-RNR GDP is highest in high-income countries. Since RNR and non-RNR growth rates are more similar in high-income countries than in developing countries (recall the findings in section 3.2), it is possible that RNR specialization predominates over non-agricultural diversification in the Imbs and Wacziarg data.

Reducing RNR's contribution to macroeconomic uncertainty[23]

Research undertaken for this report by Foster (2004) further studied the contribution of RNR activities to Latin American and Caribbean macroeconomic volatility. The corresponding econometric analysis entailed a cross-country econometric analysis both of the influence of agricultural export diversity on deviations of national economic growth rates and of the determinants of export diversity. The analysis made use of an indicator of the diversity of exports of basic and processed agricultural products based on export shares that incorporates price correlations to determine the weight assigned each product share. Compared to standard weighted averages of shares, this modified Simpson/Herfindahl measure gives added weight to products with low and negatively correlated prices (greater diversity) and less weight to products with positively and highly correlated prices (less diversity). In this manner, the diversity indicator integrates what is the most intuitively interesting aspect of export diversity in the context of the agriculture and national development discussion: the role of broader product and export mixes in mitigating the shocks to sectorial and national income arising from the concentration in few products.

There are three conclusions drawn from Foster's results worth repeating here. First, controlling for other variables, greater trade openness leads to greater agricultural export diversity. Table 3.15 provides this evidence; it shows that the ratio of exports plus imports over national GDP (national trade openness) has a positive and significant impact on the agricultural diversification index. Consequently trade

TABLE 3.15

GMM estimates of determinants of the diversity index of agricultural exports

Variable	Estimate	Standard error (robust)	z-statistic	p-value
Lagged diversity d_{t-1}	0.57	0.05	12.51	0.00
Government share of GDP	0.00	0.00	–2.65	0.01
Inflation index	0.00	0.00	–2.68	0.01
Financial depth (bank credit/GDP)	0.00	0.00	3.20	0.00
Number of tractors per 100 hectares	–0.05	0.01	–3.22	0.00
100 grams of fertilizer per hectare	0.00	0.00	–1.03	0.30
Percent land under irrigation	0.00	0.00	2.22	0.03
Log total agricultural land	–0.18	0.03	–5.40	0.00
Log agricultural GDP	0.01	0.02	0.50	0.62
Log total value Agricultural exports	–0.06	0.01	–4.86	0.00
National trade openness	0.08	0.02	3.83	0.00
Agricultural trade openness	–0.03	0.05	–0.72	0.47
Log per capita income	–0.12	0.03	–3.75	0.00
Percent population in urban areas	0.00	0.00	–1.86	0.06

Source: Foster 2004.
Note: Estimates of coefficients associated with country and year dummies omitted; number of observations: 249; F(52,196) = 4.24 p-value = 0.0000; Hansen J-statistic: 112.233, p-value = 0.475.

openness provides an indirect remedy, through the enhancement of agricultural export diversity to its magnifying effect on growth rate volatility arising in the agricultural sector.

Second, the investment environment of an economy (as measured by inflation, government burden, and financial depth) influences the degree of export diversity. Beyond their more direct influence in determining national economic development, a greater macroeconomic stability, a lower government participation in GDP, and a deeper financial market would serve to increase agricultural export diversity, and thus indirectly would serve to lessen agriculture's contribution to macroeconomic volatility.

Third, controlling for other factors, the marginal effect on agricultural export diversity of higher per capita income is negative and perhaps large. That is, all other things being equal, a richer country would have less agricultural export diversity. The observation that export diversity and development are positively correlated is due to the correlation of both variables with other factors influencing both, such as the trade openness and the economy's financial depth.

These results, combined with the previous discussion of the potential for within-sector diversification, provide a wealth of information for policy making. The RNR sector's contribution to national welfare does work, in part, via the sector's effects on macroeconomic uncertainty. Ideally, policies should aim to diversify the whole economy. But if interest remains in enhancing the RNR sector's contribution to national welfare through a reduction in volatility, then public policies could focus on developing domestic credit markets, which seems to reduce the sector's contribution to economic risk. In addition, trade policies have two effects. The direct effect is to increase the sector's contribution to uncertainty, probably by enhancing the transmission of global agricultural volatility to the domestic economy. The second indirect effect is by aiding export diversification in the RNR sector. Previous research, discussed in De Ferranti et al. (2003), had also shown that the trade reforms of the 1990s had been accompanied by a general increase in export diversification. Therefore, trade policies seem to help diversification within as well as across sectors. Chapter 6 provides more specific analyses of various policy options available to Latin America and Caribbean countries in the trade and finance fields.

3.6 The RNR sector's contribution to Latin American and Caribbean welfare and beyond[24]

The previous sections studied the causal feedback effects across RNR and non-RNR GDP. The results indicate that RNR contributes to non-RNR sector development, but there is significant heterogeneity across regions. In particular, increases in the scale of RNR production in high-income countries tend to reduce the size of the rest of the

economy. Similarly, regarding the impact of non-agricultural output on agriculture, we found a predominant resource-pull effect in non–Latin American and Caribbean developing and high-income countries that attracts resources to the non-agricultural sector, but this effect was insignificant for Latin American and Caribbean countries.

Regarding the RNR scale's effect on incomes of poor households, the econometric evidence refutes the conventional wisdom. Our results indicate that richer household quintiles benefit more from advances in RNR labor productivity than the poorest households. This chapter also examined the impact of RNR output and other economic activity sectors on three environmental outcomes. The empirical findings suggest that the sectorial environmental impacts vary across regions. In Latin America and the Caribbean, agriculture is environmentally neutral, except in the case of water withdrawals, but there are still glaring greenhouse gas emissions and ecological costs associated with deforestation caused by the expansion of the agricultural frontier in a handful of Latin American and Caribbean countries. Finally, macroeconomic volatility is significantly affected by the size of the RNR and non-RNR sectors in all countries, except for the case of RNR in high-income countries, where increases in the scale of RNR GDP is associated with small increases in volatility.

These results provide the necessary ingredients to calculate the welfare elasticity with respect to RNR and non-RNR output. As discussed in Bravo-Ortega and Lederman (2005) and in section 3.1 this elasticity depends on the econometrically-estimated elasticities, on the share of each sector in national GDP, and on current (as of 2000) environmental outcomes. Nonetheless, we acknowledge that policy makers might have other policy objectives, which we have not considered in our welfare analysis. For example, many countries pursue policies to fight the spread of illicit crop cultivation, which has become a major concern in Andean countries (see box 3.4).

In any case, our estimates of the sectorial welfare elasticities (affecting the developmental and environmental considerations only) are reported in table 3.16. The first set of calculations (row 8 in table 3.16) uses equal weights for GDP per capita, average income of the bottom quintile, the environmental index, and volatility. The second set of calculations (row 9 in table 3.16) reports welfare elasticities, assuming that GDP per capita carries 40 percent of the weight. These calculations use only statistically significant elasticities for each group of countries.

The elasticities in table 3.16 suggest that national welfare in high-income countries is best served through non-agricultural growth. This conclusion is supported by the reported pair of sectorial welfare elasticities, regardless of the assumptions concerning the weights in the national welfare function. Indeed, RNR growth decreases welfare in these countries. Developing countries' welfare is also best served by non-RNR development, although the RNR contribution is positive and relatively larger than its GDP share. In non–Latin American and Caribbean developing countries, the ratio between the welfare gains due to non-RNR growth over the welfare gains due to agricultural growth is 1.67 (not reported). When the overall development level predominates in the national welfare function, then the marginal welfare gains from non-RNR development are much larger than the gains from RNR development; indeed the ratio between them is 2.62 (not reported). In Latin America and the Caribbean, there is a 3.5 ratio between the welfare gains due to non-RNR growth over the welfare gains due to RNR growth. When the overall development level predominates in the national welfare function, the ratio between the welfare gains due to non-RNR growth over the welfare gains due to RNR growth is 3.6, slightly greater than in the previous case.

The ratios between the relative contributions to welfare and the sectorial GDP ratios are shown in rows (11) and (12) of table 3.16. These ratios measure the welfare contribution per percentage point of national GDP for each sector. A ratio equal to 1 implies that each sector's contribution is proportional to its GDP share, whereas a ratio greater than one implies that the RNR contribution to national welfare is greater than proportional to its GDP share.

For Latin America and the Caribbean these ratios are above 2, thus implying that RNR's contribution to national welfare has been about twice its GDP share of 12 percent (in the sample used for the relevant econometric exercises). This result partly comes from RNR's positive effect on the rest of the economy, which also enhances RNR's poverty-reducing effect. For the other developing countries the ratios are 2 and 1.35. These also come from agricultural growth's positive effect on the rest of the economy, but the magnification of RNR's effect on development is relatively smaller than in Latin American and Caribbean countries due to the fact that RNR's GDP share is higher in developing countries than in Latin America and the Caribbean. The high-income countries' negative ratios of –3.8 and –3.1 indicate that RNR growth entails welfare losses. This

BOX 3.4

The sectorial approach to illicit crop eradication in Andean countries, 1980–2002

The analysis in this chapter's main text focuses on the contribution of the RNR and other sectors to national welfare in Latin America and the Caribbean and other regions. This report also recognizes that governments often pursue policies that narrowly target noneconomic objectives or factors that are difficult to quantify in economic terms. One such example is related to environmental quality, as discussed in the text. Another area where quantification of the welfare effects of public policies is difficult concerns the cultivation of illicit crops.

The 1980s saw a significant increase in coca cultivation in the Andean countries. Coca, especially two varieties, has been traditionally used for legal purposes in Bolivia and Peru. However, as time progressed, it was increasingly used in illicit drugs production. Coca is the main input in the manufacture of cocaine hydrochloride, an addictive drug that has severe negative effects on its users, their societies, and also on the social fabric of producer territories. The United States is the world's largest consumer of illicit crops, and the Andean region, according to the United Nations Office on Drugs and Crime (UNODC 2004), is responsible for all the cocaine that enters Europe and the United States. In response to this, the Andean countries and the United States developed a strategy to reduce illicit coca cultivation. Since then, coca eradication has captured the attention of various sectors of society and the international community. Support for these programs has not been unanimous because of the alleged costs involved, their potential threat to cultural norms of local communities, environmental and health risks, and questionable impact due to a "balloon effect" whereby eradication in one area leads to cultivation in others.

In response to these concerns, UNODC and various governments have promoted alternative development programs to discourage illicit crop cultivation and mitigate the negative effects of coca eradication practices. Alternative development was initially a reactionary measure, but it evolved over time as a social intervention model. There has been limited empirical evidence to support the continuation of these programs, although there has been a gradual, albeit slow, decline in regional production levels. However, we do not know whether the current approach is the most effective method to eradicate coca cultivation and improve social conditions of affected farmers.

Moreno-Sanchez, Kraybill, and Thompson (2002) estimated an econometric model of coca production in Colombia and analyzed the impact of various factors on coca cultivation levels. They concluded that coca eradication is an ineffective means of supply control as farmers compensate by cultivating the crop more extensively. They further concluded that incentives to produce legal substitute crops, particularly plantains, might have greater supply-reducing potential than eradication. Other studies have sought to identify specific economic, political, and social conditions that contribute to the emergence of illegal drug production. Morrison (1997) concluded that contributing factors include isolation, economic insecurity in rural areas, and lack of enforcement caused by corruption or insurgency.

In a preliminary study, Lederman and Waite (2004) used data from UNODC and the World Bank to estimate a dynamic econometric model of the following form:

$$(1) \quad CC_{it} = \beta_{i0} + \beta_{i1}(CC)_{it-1} + \beta_{i2}(X)_{it-1} + \varepsilon_{it} + \upsilon_t$$

that is a linear model. CC is the number of hectares of coca under cultivation in the respective countries (captured by subscript *i*), and X represents other explanatory variables under investigation, namely the relative farm gate price of coca leaf in Bolivia and Peru (coca base in Colombia), the number of hectares of coca fumigated, agricultural GDP, non-agricultural GDP, the number of hectares of coca cultivated by the respective neighbors, and the volume of cocaine seized for each country. This so-called SUR-regression approach allows the cultivation functions to be different across the three Andean countries. The table below presents the results of various specifications, using either relative prices of coca or cocaine seizures as the proxies for coca demand, of model (1).

This evidence suggests that policies that are effective at the country level might not contribute to the reduction of illicit-crop cultivation at the regional level if there is no regional coordination among governments, perhaps aided by international organizations. In addition, the short-term effectiveness of eradication (fumigation) varies across countries. Even when eradication is successful, the decline in coca cultivation levels was proportional

BOX 3.4 ***continued***

Determinants of coca cultivation in Andean countries; cultivation and fumigation in levels

	Bolivia			Colombia			Peru		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Constant	–1032480 (0.12)	39317.56 (0.83)	–172242.70 (0.54)	5692158 (0.02)	–2018941 (0.15)	–5649941 (0.01)	–385757.00 (0.67)	–758908.50 (0.56)	–2463662.00 (0.12)
Coca (t-1)	0.35 (0.28)	0.48 (0.00)	0.53 (0.00)	0.42 (0.00)	0.84 (0.00)	0.62 (0.00)	–0.14 (0.61)	0.58 (0.00)	0.52 (0.01)
Agri GDP (t-1)(log)	26753.66 (0.46)	–19685.25 (0.21)	–23506.53 (0.11)	–168438.00 (0.00)	–37360.22 (0.27)	19509.59 (0.66)	218920.20 (0.00)	123685.40 (0.08)	155677.50 (0.01)
Nonagri GDP (t-1)(log)	20090.42 (0.46)	16183.36 (0.18)	28393.47 (0.07)	–7116.61 (0.85)	102261.10) (0.00)	167025.20 (0.00)	–173504.40 (0.00	–77599.80 (0.07)	–38568.84 (0.51)
Seizures (t-1)(log)		3293.50 (0.70)	4676.14 (0.04)		–3236.88 (0.43)	–11044.85 (0.06)		–836.35 (0.85)	–1637.39 (0.73)
Price (t-1)(log)	–4558.52 (0.47)			–30731.36 (0.00)			10477.93 (0.02)		
Eradication (sq)(t-1)	–1.12 (0.00)	–0.94 (0.00)	–1.09 (0.00)	–0.01 (0.92)	–0.16 (0.15)	–0.03 (0.79)	–0.38 (0.39)	–0.09 (0.86)	0.54 (0.41)
Neighbor production (t-1)	0.14 (0.15)	0.06 (0.17)	0.03 (0.69)	–1.27 (0.00)	–0.29 (0.07)	–0.51 (0.01)	–0.96 (0.00)	–0.47 (0.04)	–0.31 (0.27)
Neighbor eradication (squared at t-1)[1]	–0.19 (0.33)	–0.22 (0.16)	–0.18 (0.20)	0.31 (0.37)	0.59 (0.09)	0.63 (0.07)	0.35 (0.05)	0.17 (0.30)	–0.20 (0.43)
1993–2003 (dummy)			15454.44 (0.64)			–197881.40 (0.05)			170129.70 (0.11)
Dummy 93[a] Seizures			–2155.34 (0.53)			16874.66 (0.06)			–19040.90 (0.09)
Obs.	12	19	19	12	19	19	12	19	19
F-test	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Breusch Pagan Stat (p-value)	0.003	0.93	0.11	0.003	0.93	0.11	0.003	0.93	0.11

Source: UNODC data from 1980–2002, where available.
Note: Dependent variable: Coca cultivation measured in hectares; time series by country: Bolivia, Colombia, Peru; method: Sureg (OLS); GDP is measured in constant local currency units; numbers in brackets represent the p-values of the coefficients; dfk, small-sample standard errors were used.
a. Coefficient represents the estimated marginal effect, which equals the product of the estimated coefficient*2*average eradication.

BOX 3.4 ***continued***

only in Bolivia. Eradication seems to be effective in Bolivia, possibly in Colombia, and uncertain in Peru. Alternative development programs focused on agricultural opportunities should be effective in Bolivia, but Colombia responds to agricultural expansion by increasing coca land yields (results not reported here, see Lederman and Waite [2004]), while Peru expands coca cultivation areas at the expense of land yields. In general, we find that agricultural development may be the most effective type of alternative program in Bolivia, whereas the opposite may be the case for Peru, and perhaps in Colombia, thus contradicting the results from Moreno-Sanchez and coauthors. Different strategies will have to be adapted to local conditions, especially to those pertaining to the norms of local farming communities. Further, these findings indicate that there is a strong contagion effect—a "balloon effect"—across the region.

Source: Lederman and Waite 2004.

TABLE 3.16

Contributions of agriculture and non-agriculture to national welfare as of 2000

		Latin America and the Caribbean		High-income countries		Other countries	
		Ag	*Non-Ag*	*Ag*	*Non-Ag*	*Ag*	*Non-Ag*
1	Contribution through GDP	0.22	0.88	–0.05	0.97	0.34	0.74
2	Contribution through income of the poor	0.28	0.77	–0.08	0.90	0.46	0.58
3	Contribution through air pollution	–0.02	–0.18	0.03	–0.29	–0.06	–0.08
4	Contribution through freshwater withdrawals	–0.21	0.00	–0.25	0.00	–0.09	–0.06
5	Contribution through deforestation	0.00	0.00	0.00	0.00	–0.04	0.05
6	Contribution through environmental index (1/3)•((3)+(4)+(5))	–0.08	–0.06	–0.07	–0.10	–0.06	–0.03
7	Contribution through macro volatility	0.04	0.04	–0.01	0.07	0.05	0.01
8	Contribution to national welfare (e.g., weights: (1) + (2) + (6) + (7))	0.12	0.41	–0.05	0.46	0.19	0.33
9	Contribution to national welfare (GDP = 40 percent, others 20 percent)	0.14	0.50	–0.05	0.56	0.16	0.41
10	GDP share (sector GDP/total GDP)	0.12	0.88	0.03	0.97	0.22	0.78
11	Ratio of welfare contribution ratio/GDP ratio (e.g., weights)	2.12		–3.84		2.12	
12	Ratio of welfare contribution ratio/GDP ratio (GDP = 40 percent)	2.03		–3.14		1.35	
	Memo items: Elasticity of variable with respect to each sector						
	GDP of the other sector	0.12	0.00	–0.09	0.00	0.15	–0.17
	Income of the poorest households	0.19	0.77	0.00	0.90	0.36	0.64
	Air pollution (CO_2 emissions)	0.00	1.04	0.00	0.38	0.38	0.74
	Freshwater withdrawals	1.40	0.00	1.66	0.00	0.66	0.65
	Deforestation	0.00	0.00	0.00	0.00	0.04	–0.05
	Macro volatility	–0.039	–0.041	0.01	–0.07	–0.05	–0.02

Sources: Bravo-Ortega and Lederman 2005, table 7. See also text in this chapter for details.
Note: Ag = agriculture; Non-ag = non-agriculture.

is due to the fact that RNR output in developed countries has a net resource-pull effect that hampers the non-RNR sector's growth, which in turn reduces agriculture's contribution to national welfare. Bravo-Ortega and Lederman (2005) argue that this result is consistent with agricultural growth patterns observed in the United States, where it has been characterized by notable productivity improvements that have nonetheless attracted human capital into the sector (Acquaye et al. 2003). Chapter 5 in this report further discusses patterns of RNR productivity growth throughout the world.

Since policy makers are interested in maximizing national welfare, these calculations have important policy implications, for they go to the core of policy decisions regarding public sector investments or private investment incentives across sectors, budget allocations for publicly-supported research and extension services (or R&D subsidies for non-agricultural activities), or the burden of taxation borne by different sectors (Johnston and Mellor 1961). These issues are discussed in chapter 5.

For Latin American and Caribbean countries, however, there are definitive tradeoffs despite the fact that agriculture

has a rather large positive spillover plus multiplier effects on the rest of the average Latin America and Caribbean economy. In particular, agriculture is not as pro-poor when contrasted with non-agricultural growth (see row 2, table 3.16), and it accounts for a relatively small portion of the national economy (see row 10, table 3.16). There seem to be two broad policy paths for the average Latin American and Caribbean economy. One is to maintain a sector-neutral tax burden, including neutral trade policies, combined with important public investments to stimulate agricultural productivity growth such as R&D subsidies, plus public education and infrastructure investments. This strategy could also be complemented by public investments and subsidies to enhance the linkages between agricultural commodity production and its upstream food processing industries. The latter is justified by our finding that the positive externalities of Latin American and Caribbean agriculture might be greater when it includes these upstream industries. Another alternative is to implement social and economic reforms that will increase the poverty-reducing effects of RNR growth. Most of these policy issues are covered in the second part of this report encompassed by chapters 5–9. The following chapter turns to the spatial or territorial approach for understanding the rural contribution to development.

Notes

1. The regression coefficients in columns (2)–(4) come from country fixed-effects regressions, whereas columns (5)–(10) present results from two-stage regressions with fixed effects (Baltagi 2002). Consequently, all the estimates under columns (2)–(10) correspond to the effect of development (increases in the log GDP per capita) on RNR GDP share over time within countries.

2. It is not clear whether Larson and Mundlak (1997) studied labor migration from commodity agriculture, including forestry and fisheries, or whether they looked only at crop agriculture. Thus we use the term agriculture in this paragraph instead of RNR.

3. Soto and Torche (2002) discuss evidence suggesting that housing subsidies in Chile have been associated with lower migration rates. These authors also argue that such policies thus thwart the poverty-reducing effects of overall economic growth across Chilean regions.

4. Ideally, we also want to know whether this large effect of the extended-RNR sector on the rest of the economy varies across Latin America and Caribbean countries. Unfortunately, data limitations prevented us from conducting this exercise.

5. De Ferranti et al. (2004) conclude, based on the analysis by Carter, Barham, and Mesbah (1996), that Chile's small landholders' sector suffered farm income losses and declining numbers during the export boom, which were partially offset by employment growth on larger farms, although these jobs were seasonal with stagnant or declining wages. This analysis, however, overlooks off-farm employment in postharvest and other processing activities and in non-agricultural jobs, such as services and transport. Labor income of unskilled workers increased in Chile as it was stimulated by the expansion of production in agriculture and associated agro-industrial activities oriented toward exports.

6. Food price declines would affect households differently, based on the weight of food in expenditures. The poverty threshold is common to all families. Due to a reduction in the poverty threshold accompanied by food price decreases, some families would exit poverty even if their nominal income remains unchanged.

7. The estimated long-run elasticity of nontradable food prices with respect to agricultural output is approximately -0.6 in Chile.

8. Soloaga and Torres (2004) applied instrumental variables to avoid endogeneity problems in regional rural and urban income measures. Also, these authors used the official survey definitions of rural and urban dwellers.

9. In technical language, migration remittances or improved subsistence farming might increase the reserve wage of rural dwellers, thus reducing their incentives to migrate to urban labor markets at a given wage.

10. See Pretty et al. (2000), Barbier (2004), and Lewandrowski et al. (1997). For a survey of various papers, see Landry and Mistiaen (2002).

11. Lewandrowski et al. (1997); Pretty et al. (2000).

12. Data and documentation are available from www.cait.wri.org.

13. The p-value of the F-test for the significance of the high-income countries' coefficient is not reported.

14. Robert Schneider (World Bank) wrote this section.

15. They correspond to the FAO categories of permanent pastures, permanent crops, and arable land.

16. As in the previous empirical exercises, deforestation data over the 1990–2000 decade come from the FAO Global Forest Resource Assessment 2000 (2001).

17. This is made up of 20,000 km^2 of permanent crops and 135,000 km^2 of annual crops.

18. Put differently, if this land, identified as being deforested by the Forest Assessment, were in crops, as opposed to shrubby pasture, there would be no ambiguity as to whether it is in forest or agricultural use.

19. It is also likely that some unknown portion of the increase in annual crops represents new deforestation due to displacement of pasture by crops (for example, displacement of pasture by soybeans in Mato Grosso, Eastern Paraguay, and the Bolivian lowlands). This shifting of the cattle frontier to the forest would result in the increase in land use that would show up in the statistics as predominantly crops, while the observed use of converted forests is pasture.

20. We have chosen the cereals potential category of marginal and above at low technology levels.

21. Bailey Klinger (Harvard University) and Daniel Lederman (World Bank) wrote this section.

22. This section comes from Bravo-Ortega and Lederman (2005).

23. This section borrows heavily from Foster (2004).

24. This section comes from Bravo-Ortega and Lederman (2005).

CHAPTER 4

The Promise of the Spatial Approach

4.1 The spatial approach: A new fad or old concerns?

The spatial approach to development, which focuses on the territories within countries, is again fashionable. IADB researchers published a book titled *Is Geography Destiny?* Another book is titled *Rural Regional Development.*

On the one hand, the current fad is justified by on-the-ground experiences. Simply put, rich regions seem to be getting richer while poor regions lag behind. This is a standard finding of the now vast literature on regional patterns of economic growth within national boundaries. At least this is the case for some of the largest economies of the Latin American and Caribbean region, including Mexico (Bosch and Maloney 2003; Esquivel and Messmacher 2003), Brazil (Magalhaes, Hewings, and Azzoni 2003), Chile (Soto and Torche 2002), and Colombia (Bonet 2003). But this has also been the case within the national boundaries of the European Union members, despite the substantial resources that have been invested to help develop laggard regions (Fiess and Fugazza 2002).

On the other hand, there is also substantial evidence of "conditional" convergence across regions within countries. This approach controls for regional characteristics, such as the workforce's average education level in each region, infrastructure coverage, and so forth. This is the case for Mexico in the 1990s (Esquivel and Messmacher 2003; Lederman, Maloney, and Servén 2004), Chile during the past few decades (Soto and Torche 2002), and in numerous other countries around the world (Barro and Xala-i-Martin 2002). The implication of these findings is that poor regions can grow faster than rich regions as long as they can achieve the levels of education and infrastructure coverage observed in the rich areas. But when factors of production can migrate across regions to take advantage of higher economic payoffs offered by the already-successful economic centers, it is not clear that policies that invest in education or infrastructure in laggard regions will necessarily produce economic development in the target territory.

Nevertheless, due to a variety of reasons, governments throughout the world have experimented with various types of territorial development policies, based on the predictions of various analytical approaches. Latin American and Caribbean governments have not been an exception. The region has experimented with fast economic and political decentralization (World Bank 2000) governments have implemented development programs based on the construction of regional industrial clusters and have explicitly targeted the development of certain regions for geo-strategic reasons. Despite all the experimentation, we still know little about the development effectiveness of many of the chosen policies.

This chapter explores the promise of the spatial approach to rural development by addressing a most fundamental policy question: Do territorially targeted development policies stand a chance of success? A necessary condition for the success of such policies is that regional characteristics, above and beyond the individual characteristics of their residents, must make a difference for the pace of economic development, for job creation, and for improving the livelihoods of workers. The evidence below provides hope: regional and community characteristics do matter for development, jobs, and wages. Moreover, there is no necessary contradiction between the sectoral approach used thus far in chapter 3 and the spatial approach that focuses on territories rather than certain economic sectors. Chapter 9 discusses the main policy challenges that need to be confronted when designing effective regional development policies.

The following section presents the territorial approach's main conceptual underpinnings. Section 4.3 discusses the analytical relation between the sectoral and territorial approaches by demonstrating empirically that there are no inconsistencies in combining both approaches, because there seems to be a tight relationship between population density (a spatial concept) and the concentration of RNR economic activities. In turn, section 4.4 presents new evidence on the promise of the spatial approach by illustrating how regional characteristics affect both the number and quality of jobs in regions within Latin American and Caribbean countries. The final section summarizes the main findings.

4.2 The extensive menu of concepts that justify spatial development programs[1]

The policy menu from which policy makers can choose is broad, and several conceptual frameworks date back to the early 1950s, thus revealing that the spatial approach is not necessarily new. The scientific literature, which is grounded on rigorous reasoning, can be divided into four broad categories, namely the key sectors, the growth poles, the clusters, and the economic agglomeration approaches. These are discussed in the following subsections.

Economic agglomeration and the new economic geography

It would seem that there would be a strong connection between these approaches and the important role that agglomeration plays in the new economic geography literature and its link with trade theory. However, that connection has not been made explicitly although the vertical specialization ideas (see Hummels et al. 1998, 1999) do offer one potential link. As Venables (2001) has noted, cumulative causation's role has been a dominant feature of much of the work associated with development. Externalities in general serve to create competitive advantages of some locations over others, but the form in which they are manifested in space may vary according to the sophistication of the transportation network, the level of per capita income, and consumer preferences. Generalizing the methodology presented in Fujita et al. (1999) Venables notes that trade costs play a very significant role; high costs lead to firm locations close to consumers, whereas low trade costs allow firms to consider other issues (such as supply) in seeking an optimal location. At intermediate trade costs, the potential for clustering is greatest.

However, as Parr et al. (2002) have suggested, it is important to recognize a distinction between the firm and establishment. Venables' theoretical findings appear to be applicable in considering the location patterns within the United States (low domestic trade costs) and developing countries (high trade costs). However, closer inspection of the U.S. case reveals that agglomeration effects can be observed in regions as extensive as the Midwest; improvements in transportation costs make it possible for next-day delivery by road for distances of 500 miles. Accordingly, there is evidence that firms are organizing production in establishments to realize scale economies through establishment-level specialization and performing the sort of vertical specialization identified by Hummels et al. (1998, 1999) at the international and inter-regional levels.

A couple of examples can help clarify the ongoing discussion. The Midwest states have very similar macro structures (the percentage of output that each sector accounts for), but the internal structures are very different, reflecting differences in products produced and thus the associated supply chains (see Hewings et al. 2001). In fact, the Chicago regional economy has been experiencing a process of hollowing out, whereby the intermediation level in production is actually declining, while production levels continue to increase in real terms (Hewings et al. 1998). Munroe Hewings, and Guo (2003) have found, not surprisingly, that trade between the Midwest states is dominated by intra-industry trade, a finding consistent with the tenets of the new trade theory. While the notion of agglomeration and clustering suggests spatial proximity, low trade costs may extend the notion of proximity to distances beyond the metropolitan scale. In contrast, northeastern Brazil exhibits limited interstate trade, reflecting limited markets and a transportation network that is oriented more to the rest of the country rather than between states (see Magalhães et al. 2001).

For some readers this brief review of recent advances in the new economic geography and trade literature might smell like old wine in new bottles. Indeed, some of the literature's basic pillars, such as an emphasis on the structure and transport-intensity of different economic activities, can be traced to older concepts.

Key sectors

The development of regional level input-output tables generated a surge of interest in the evaluation of regional economic structure beginning in the 1950s. Moving beyond the classifications of Kuznets that were based on shares of gross product or employment claimed by major segments of the economy (primary, secondary, tertiary), analysts quickly adopted what may be referred to as Hirschman-Rasmussen key sector analysis. The claim here was that, in

any economy, a small set of sectors would serve as the economic growth engines through forward and backward linkages, as mentioned in chapter 2. The old-fashioned policy implication was that identification of such key sectors would enable policy makers to focus attention on their promotion (or, in some cases, their attraction).

McGilvray, for one, is very pessimistic about this approach's value; he claims that if one views the world as Leontief (that is, characterized by interdependence), then one would be hard-pressed to isolate a few sectors as more important than others in promoting inter-sector agglomeration economies. In fact, he offers the idea that perhaps the "non-key" sectors may be even more important than the key sectors. The argument suggests that the key sectors may have located in the region because they were attracted by suppliers or forward markets, and thus to separate them from other sectors may be misleading.

Growth pole, growth center, and industrial complex analyses

The dissatisfaction with the key sector idea's restrictiveness was answered, in part, by the proposal for identifying growth poles *(pôles de croissance)* (Perroux 1955). This author envisioned sets of industries interacting to generate a synergetic impact on the economy, but he offered little methodology to identify these growth poles. A parallel development can be found with the notion of industrial complexes (Isard et al. 1959; Czamanski 1973, 1974) that draws inspiration from the input-output approach. These ideas have subsequently been translated to form cluster analysis (Bergman and Feser 1999), now one of the most popular approaches to regional development strategy.

Growth pole theory has proved attractive since it embraces in one conceptual framework a number of different theories and ideas that have been developed in regional analysis. Thomas (1972) cautioned that there were a number of deficiencies with the theory—a lack of knowledge concerning the growth processes within poles over time, the paucity of information about the nature and significance of the spatial components of inter-industry linkages, and implementation difficulties.

Hansen (1972) viewed a growth center as a complex consisting of one or more communities that jointly provide a range of cultural, social, employment, trade, and service functions for itself and its associated rural hinterland. Though a center may not be fully developed to provide all these functions, it could provide, or potentially provide, some elements, which would make it identifiable as the logical location for many specialized services for people in surrounding rural areas.

Moving from the identification of a potential growth pole to the stimulation of regional development is challenging. For example, much of the literature on clusters has derived its inspiration from the successes of Silicon Valley, where the degree of interaction is strong. However, even here, the degree of industry interdependence is often not strong. Establishments are locating to derive, in many cases, externalities that are not associated with production linkages, but rather are associated with the regional workforce's skills and knowledge. An extensive discussion of these issues and the idea of knowledge clusters was presented in a previous World Bank report (De Ferranti et al. 2002).

Clusters, keystone sectors, and other concepts

Cluster analysis also provides a link with several other approaches, the concept of a keystone sector, the identification of structural holes, and the role of agglomeration economies associated with the application of the new trade theory. Each of these will be addressed in turn.

The Hirschman-Rasmussen key sector identification essentially focuses on the backward and forward linkages of individual sectors. Two approaches extend the Hirschman-Rasmussen linkages view by incorporating a sector's role in the local or regional economy. The first approach was proposed by Cella (1984, 1986) and Clements (1990) and elaborated in the notion of a pure linkage concept by Guilhoto et al. (1999). Kilkenny and Nalbarte (2002) exploited the keystone sector idea, drawing on the physical analogy of the keystone's role in linking two sides of an arch to suggest a sector playing the most critical role in the economy (that is, providing a bridge between major components of the economy).

The advantage of these approaches is that they highlight the fact that a sector with significant multiplier effects may not generate significant growth if it is small in size, as discussed in chapter 3. Kilkenny and Nalbarte's keystone approach also considers social as well as economic networks; in many cases, two apparently similar (from an economic perspective) regions may have different development trajectories that can be traced to differences in the ways that entrepreneurs, community leaders, and bankers, for example, interact. Recent work by Carvalho (2002) has identified striking differences between experience in the United States and Portugal in the role of social networks.

Many of these policy-relevant themes will be revisited in chapter 6. At this point, it is sufficient to state that regional policies designed for the mid-20th century will need to be revisited in light of enhanced understanding of how regional

economies develop and, equally important, external trade's ever-increasing role—both inter-regional and international—in generating the demand for a region's goods and service. Since agriculture and other RNR economic activities require the use of land as a factor of production, it is natural for such activities to be inextricable from regions within countries that provide such land and are also characterized by low population densities. Consequently, there might not be an inconsistency in pursuing policies that target the competitiveness of RNR activities, while at the same time, they aim to develop certain territories. This complementarity is the subject of the following section.

Rural-urban linkages and the territorial approach[2]

Interest in rural-urban linkages has grown rapidly over recent years, among both academics and development practitioners. This interest has been manifested in the so-called "livelihoods" and "assets" approach to rural development, widely popularized by DFID,[3] and the "territorial" approach, based on the European Communities LEADER Community Initiative[4] that the FAO vigorously promoted throughout the Latin American and Caribbean region. There is also much literature on rural nonfarm markets that also emphasizes the important role played by nonfarm employment in promoting both growth and welfare, in particular through generating employment and slowing rural-urban migration. The literature on territorial approach therefore builds on the nonfarm employment literature. It is also strongly influenced by the model of "social fund"[5] projects. These projects rely on local communities to make public investment decisions. The territorial approach can thus be seen as an effort to expand the social fund approach to involve a wider range of economically important actors. It emphasizes the importance of harnessing economies of scale provided by urban agglomerations and the links to global markets that can enhance the productivity of rural economic activities. Consequently, this practical literature is also conceptually related to the growth poles and economic agglomeration literature mentioned above.

4.3 The spatial approach complements the sectoral approach

There are various ways of analyzing the complementarity between the sectoral and spatial approaches. One is to study how the degree of sophistication of agricultural production affects the quality of employment in Latin American and Caribbean countries across high- and low-population-density areas. This method is pursued below. Another is to examine how various regions within countries have achieved dramatically different agricultural productivity levels. This approach is also discussed below. Both approaches suggest that regional development is tied to sectoral development when the relevant economic activities use factors of production that are immobile, as is the case of land in agricultural activities. The main implication is that regional development policies (RDPs) might be more effective in stimulating territorial development when they are linked to key sectors that are defined by their use of immobile factors of production.

However, as will be discussed below, there is also strong evidence suggesting that even the development of economic activities that use fixed factors of production can have notable spillover effects on communities that do not specialize in agricultural production. That is, the welfare of urban families can also improve as a consequence of rural development, thus making the results reported below consistent with the evidence presented in chapter 3.

The link between agricultural and rural development and welfare across Latin American and Caribbean rural and urban populations

Gasparini, Gutierrez, and Porto (2004) undertook an innovative analysis for this report that combines national-level indicators of the sophistication of agricultural production with household income data across a dozen Latin American and Caribbean countries. The authors relied on a dataset that contained 60 household surveys covering the period 1989–2002, which is an expanded version of the data used by Gasparini (2003). The sample comprises more than 4 million individuals surveyed in 17 Latin American and Caribbean countries: Bolivia, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, and Republica Bolivariana de Venezuela. All household surveys included in the sample are nationally representative. We excluded Argentina and Uruguay from the analysis, since surveys in these countries cover only urban populations. All surveys record a basic set of demographic, education, labor, and income variables at the household and individual levels. Although there are differences across countries, surveys are roughly comparable in terms of questionnaires and sampling techniques. The sample represents more than 85 percent of the total Latin American and Caribbean population.

Country rural development data are gathered from a variety of different sources. The World Bank SIMA database is the major source consulted. We consider six variables linked to rural development for which country data are available: (a) fer-

tilizer consumption (per hectare of arable land); (b) irrigation (percentage of cropland with irrigation); (c) agricultural machinery (per 1,000 agricultural workers); (d) tractors (number per 100 hectares of arable land); (e) sanitation (share of rural population with access to improved sanitation facilities); and (f) water (share of rural population with access to improved water source). The first two indicators are linked to investments that increase agricultural productivity and are expected to be associated with higher wages in rural areas. While machinery and tractors also increase productivity they may be more likely to reduce the unskilled labor demand in rural areas. The access to sanitation and water reveals improvements in the living conditions in rural areas, which may affect productivity, but may well be the consequence of higher wages and incomes.

Tables 4.1 and 4.2, show the main results of estimating two empirical models linking agricultural development indicators

TABLE 4.1

The impact of national indicators of agricultural and rural sophistication on rural wages (effects of a 1 percent increase in each indicator on wages of rural prime-age males, percent)

	Fertilizers (i)	Irrigation (ii)	Machinery (iii)	Tractors (iv)	Sanitation (v)	Water (vi)
Model 1						
Variable alone	0.171	0.013	1.061	0.171	0.019	0.053
	(2.13)***	(1.97)**	(0.14)	(1.85)*	(5.10)***	(4.52)***
Model 2						
Variable*edu1	0.136	0.014	0.046	0.089	0.017	0.047
	(1.50)*	(2.12)**	(0.01)	(0.82)	(4.19)***	(3.89)***
Variable*edu2	0.173	0.013	8.071	0.216	0.014	0.045
	(2.04)**	(1.94)*	(1.04)	(2.22)**	(3.44)***	(3.69)***
Variable*edu3	0.241	0.009	–13.871	0.192	0.029	0.057
	(2.57)***	(1.02)	(–1.83)*	(1.22)	(6.78)***	(4.89)***
Observations	86525	96130	96130	96130	45130	45130
Adjusted R-squared	0.1656	0.1871	0.185	0.187	0.1858	0.1856

Source: Gasparini, Gutierrez, and Porto (2004, table IV.1), based on data from the World Bank and national household surveys for various countries. See text for details.
Note: Estimated from micro data of a sample of 61 household surveys and aggregate data; t-statistics in parentheses; * = significant at 10 percent; ** = significant at 5 percent; *** = significant at 1 percent. Estimated by weighted OLS.

TABLE 4.2

The impact of national indicators of agricultural and rural sophistication on urban wages (effects of a 1 percent increase in each indicator on wages of urban prime-age males, percent)

	Fertilizers (i)	Irrigation (ii)	Machinery (iii)	Tractors (iv)	Sanitation (v)	Water (vi)
Model 1						
Variable alone	0.061	0.006	–6.294	0.028	0.005	0.01
	(1.02)	(1.33)	(–0.93)	(0.32)	(5.62)***	(3.56)***
Model 2						
Variable*edu1	0.128	0.001	–2.088	–0.003	0.005	0.007
	(1.67)	(0.09)	(–0.33)	(–0.03)	(1.91)**	(2.78)***
Variable*edu2	0.066	0.005	–4.785	0.046	0.002	0.009
	(1.01)	(1.18)	(–0.75)	(0.57)	(1.47)	(3.62)***
Variable*edu3	0.055	0.007	–9.077	0.021	0.005	0.012
	(0.49)	(1.50)	(–1.50)	(0.22)	(4.57)	(5.23)***
Observations	163920	163920	163920	163920	110351	110351
Adjusted R-squared	0.2952	0.2953	0.2953	0.2952	0.2859	0.286

Source: Gasparini, Gutierrez, and Porto (2004, table IV.1), based on data from the World Bank and national household surveys for various countries. See text for details.
Note: Estimated from micro data of a sample of 61 household surveys and aggregate data; t-statistics in parentheses. * = significant at 10 percent; ** = significant at 5 percent, *** = significant at 1 percent. Estimated by weighted OLS.

to labor-market outcomes in rural and urban areas. Model (1) includes the rural development indicators without any interactions, whereas in model (2) the variables of interest are interacted with educational categories of the household heads. The analyses consider six rural development variables: fertilizers, irrigation, machinery, tractors, sanitation, and water.[6] The use of fertilizers and irrigation seems to be positively associated with rural wages (and with higher agricultural output per worker as discussed). Fertilizers and irrigation increase agricultural labor productivity (recall the chapter 3 evidence) and thus translate into higher wages in rural areas, but not in urban areas. In rural areas all wages go up, regardless of the worker's educational level. There is some evidence that fertilizers increase relatively more the wages of the unskilled, whereas irrigation is associated with higher wages for the skilled rural workers.

Investment in agricultural machinery does not seem to be associated with higher wages either in rural or in urban areas. Column (iii) in table 4.1 shows a weak positive link between the use of tractors and rural wages, especially for semi-skilled workers. As discussed above, while agricultural machinery increases labor productivity, it may displace labor, and hence reduce the labor demand. The results of the tables suggest that the net effect of these factors on wages would be close to zero.

Access to sanitation and water is highly correlated with wages in rural areas. As discussed above, this fact could reflect higher productivity of workers as a consequence of better living conditions and health status, but it could also mean that higher wages and income allow investments in sanitation and improved water sources. In any case, the regression results show that this relationship is positive and strong. It is interesting to note that this link is also present in urban areas, thus implying that there might be noticeable spillovers from improved living standards in regions with low population densities to Latin American and Caribbean urban centers. This evidence is consistent with the chapter 3 findings that suggested that the development of Latin American and Caribbean RNR activities is, on average, associated with the development of other economic activities.

In principle, it would be interesting to see how the model behaves when several rural development indicators are simultaneously included in the regressions. It should be noted, however, that the aggregate indicators vary by country and year, not by individuals. This means that the simultaneous inclusion of several rural development variables may cause strong colinearity among the regressors, leading to inflated standard errors. There are signs of these problems in the ongoing empirical analysis. When Gasparini and his coauthors estimated the model with all the rural development variables together, most coefficients lost their statistical significance. Nevertheless, this should not cloud the relevance of the partial conditional correlations reported in table 4.1, because the relevant explanatory variables are highly correlated and thus it is difficult to be certain about the precise magnitude of each effect.

In this chapter we are interested in assessing not only the link between rural development and *mean* rural and urban wages, but also especially the link between rural development and the *distribution* of wages. Some rural development measures may increase mean rural wages, but is this increase generalized across conditional wage strata? An attempt to shed some light on this issue was introduced in model (2), where interactions between rural development indicators and individual education were considered. The correlations between some rural development measures and wages seem to be stronger for some education groups than for others. The authors conducted additional empirical exercises attempting to assess the robustness of these results across quintiles of Latin American and Caribbean households. The evidence discussed in Gasparini, Gutierrez, and Porto (2004) suggests that there are no statistically different effects of the rural development indicators on the various segments of the population. In any case, the evidence does support the contention that policies that aim to improve the competitiveness of agriculture or raise the living standards of rural populations can have effects on households living in low-population-density areas and, in some instances, these factors can even have positive spillover effects to regions characterized by high population densities (urban areas).

Regional patterns in agricultural productivity—the case of Ecuador[7]

The empirical estimations that Larson, León, and Mugai (2004) conducted, which are also discussed in chapter 5 of this report, can be deployed to further our understanding of spatial patterns in Ecuador's agricultural productivities. Chapter 5 presents the technical description of the econometric strategy and underlying theory. Table 4.3 gives the results from this exercise. The table illustrates the significant heterogeneity of farming scale and farm output levels among Ecuador's provinces. Calculations based on the model estimates also show that these differences arise from large differences in factor use in combination with generally smaller but significant productivity differences.

In table 4.3 output differences attributable to factor use are further broken down into differences related to land,

TABLE 4.3

Agricultural output differences due to factor use across Ecuadorian provinces (deviations from the national average, percent)

			Components of factor differences			
Province	Scale	Factors	Labor	Land	Other inputs	Capital
Azuay	Small	–9.57	–0.47	–5.28	0.08	–3.91
	Medium	–25.94	–1.23	–12.47	–6.87	–5.37
	Large	–65.06	–2.89	–37.67	–18.93	–5.57
Bolivar	Small	–12.2	–1.18	–15.93	10.87	–5.95
	Medium	–32.7	–1.37	–27.74	3.77	–7.37
	Large	–54.96	–4.62	–32.92	–9.36	–8.06
Canar	Small	–4.13	–0.1	–4.12	2.44	–2.34
	Medium	–21.12	–0.03	–13.06	–8.2	0.17
	Large	–1.46	–1.16	–4.25	2.71	1.24
Carchi	Small	1.75	0.64	3.22	–4.11	1.99
	Medium	5.74	0.18	–1.22	1.81	4.97
	Large	–19.82	0.15	–27.65	4.49	3.2
Chimborazo	Small	–5.78	–0.87	–4.6	1.57	–1.88
	Medium	–23.23	–0.7	–12.64	–7.32	–2.56
	Large	–49.31	–3.41	–30.57	–12.09	–3.24
Cotopaxi	Small	–21.02	–0.44	–9.54	–7.92	–3.13
	Medium	–17.6	0.39	–18.96	0.01	0.96
	Large	4.63	3.61	–5	4.09	1.93
El Oro	Small	22.47	0.45	11.13	8.47	2.42
	Medium	18.75	1.1	10.21	2.29	5.14
	Large	4.47	3.04	–4.35	2.76	3.03
Esmeraldas	Small	–1.73	–0.06	–16.93	14.5	0.76
	Medium	–31.17	–1.33	–27.45	–3.79	1.4
	Large	–48.44	–2.42	–30.9	–13.78	–1.34
Guayas	Small	12.46	0.5	12.04	1.82	–1.9
	Medium	30.24	0.52	12.91	16.84	–0.03
	Large	82.05	2.97	17.53	56.65	4.91
Imbabura	Small	0.08	–0.15	–0.97	3.68	–2.48
	Medium	–6.84	–0.64	–1.61	–2.97	–1.62
	Large	1.61	0.93	–6.72	5.18	2.22
Loja	Small	–2.85	–0.27	1.99	7.53	–12.11
	Medium	–24.36	–0.99	–5.63	–5.96	–11.78
	Large	–67.19	–5.04	–29.81	–20.61	–11.73
Los Rios	Small	–3.07	0.18	–17.42	13.43	0.74
	Medium	4.5	–0.44	–14.93	17.39	2.48
	Large	82.66	4.01	24.25	48.72	5.68
Manabi	Small	–1.03	1.12	–3.85	6.4	–4.7
	Medium	–20.82	0.14	–15.91	–0.96	–4.1
	Large	–47.4	–2.28	–32.66	–10.04	–2.4
Morona Santiago	Small	–43.19	–0.54	–53.08	11.96	–1.53
	Medium	–184.71	–0.86	–169.13	–7.39	–7.32
	Large	–147.32	–4.98	–100.51	–29.76	–12.07
Napo-Orellana	Small	–37.67	1.64	–37.82	4.35	–5.84
	Medium	–91.24	0.54	–78.17	–8.29	–5.32
	Large	–130.24	–3.15	–88.2	–27.08	–11.81
Pastaza	Small	–64.43	1.32	–59.3	4.25	–10.7
	Medium	–97.15	0.11	–81.12	–12.62	–3.52
	Large	–133.81	–3.73	–94	–22.36	–13.72
Pichincha	Small	–5.6	0.47	–9.57	–0.61	4.11
	Medium	2.14	3.93	–3.98	–3.19	5.38
	Large	8.01	5.7	–6.36	4.14	4.53
Sucumbios	Small	–137.9	–0.01	–144.82	15.2	–8.28
	Medium	–88.37	0.38	–79.93	–2.22	–6.59
	Large	–120.85	–3.55	–75.99	–25.59	–15.72

TABLE 4.3 ***continued***

Province	Scale	Factors	Components of factor differences			
			Labor	Land	Other inputs	Capital
Tumgurahua	Small	–17.63	0.22	–6.54	–19.2	7.9
	Medium	9.54	0.96	–3.06	1.04	10.6
	Large	–15.85	–0.2	–28.97	6.87	6.45
Undelimited areas	Small	–4.17	0.3	–10.14	6.49	–0.83
	Medium	3.65	–0.49	0.31	4.68	–0.86
	Large	15.95	–1.18	–2.87	17.27	2.73
Zamora Chinchipe	Small	–77.57	–0.38	–42.1	12.22	–47.3
	Medium	–71.7	–2.49	–43.86	–8.15	–17.2
	Large	–150.03	–5.43	–98.08	–30.13	–16.4

Source: Larson, León, and Mugai (2004), based on Ecuador's 2002 agricultural census data.

labor, other input use, and capital. The land differences include the amount of land used and also whether the land is irrigated or rain-fed. As might be expected, land differences explain a large portion of differences in regional average farm output. This mostly implies a variation in the average amount of land that was planted to crops; however, recalling that irrigated land elasticities were slightly larger than rain-fed elasticities, a smaller portion can also be attributed to differences in the portion of irrigated land. Differences due to differences in labor use were relatively small across provinces and across farm size. Differences in fertilizer use and other inputs were quite large for some provinces, especially for large-scale farms. Overall, differences related to capital were not large.

In table 4.4 differences in total factor productivity are further broken down into effects by subcategories. The

TABLE 4.4

Agricultural productivity differences due to factor use across Ecuadorian provinces (deviations from the national average, percent)

Province	Scale	Productivity	Components of total factor productivity differences					
			Household	Markets	Government programs	Social capital	Risk	Nature
Azuay	Small	–11.6	–5.9	–19.4	0.2	2.1	2.9	8.5
	Medium	–17.8	–6.7	–12.3	0.3	0.3	–24.1	0.5
	Large	–15.5	–5	–5.2	0	–2.7	–30.5	–2.6
Bolivar	Small	–18.3	–0.2	3.9	–0.1	–0.7	–12	–9.2
	Medium	–7.8	–8.4	2.8	0.2	–2.4	–10.5	–0.1
	Large	–9.5	–7.8	–0.5	0	–2.2	17.7	0.9
Canar	Small	–22.4	–9.9	–8.7	0.1	–2.8	–8.5	7.5
	Medium	–10.7	–5.6	–2.8	1	–4.1	–34.3	0.7
	Large	2.8	–1.1	1.8	0.2	3.6	–14.7	–1.7
Carchi	Small	3.7	6.2	10.2	1.8	3.2	–17.7	–0.1
	Medium	17.4	4.9	3.9	0.4	2.9	–21.4	5.3
	Large	–0.1	0.4	–0.4	0.8	–1.2	–22.7	0.3
Chimborazo	Small	–14.5	0.1	3.7	0.2	–8.3	–10.7	0.6
	Medium	–21.4	–2.5	–2.6	0.6	–11.3	–23	–5.6
	Large	–2.3	–1.8	–3.8	0.2	3.4	–19.1	–0.3
Cotopaxi	Small	–30.2	–6.3	–0.6	–0.1	–3.1	–12.4	–7.8
	Medium	–14.2	–6.1	–0.7	0.5	–8.3	–18.7	0.5
	Large	6.1	1.8	2.2	0.4	1.2	–0.3	0.6
El Oro	Small	15	–7	8.8	0.2	3.1	9.1	0.9
	Medium	5.5	3.8	2.1	0.5	2.4	15.2	–3.2
	Large	3.1	1	2.4	0.3	–1.4	7	0.8

TABLE 4.4 ***continued***

Province	Scale	Productivity	Components of total factor productivity differences					
			Household	Markets	Government programs	Social capital	Risk	Nature
Esmeraldas	Small	28.2	2.4	8.4	–0.3	4.8	7.3	5.5
	Medium	24.4	8.5	1.8	–1.9	4	15.6	12
	Large	2.4	–0.1	1.8	–0.4	0.5	6.3	0.6
Guayas	Small	38.1	4.2	11.3	–0.7	3.8	17.5	1.9
	Medium	8.7	–2.9	6.3	–0.4	5.4	28	0.2
	Large	7.7	2.6	5.3	0	–0.2	37.5	–0.1
Imbabura	Small	–36.2	–3.3	–17.4	–0.1	–7.5	–0.6	–7.2
	Medium	–12.5	–2.3	–4.1	0.4	–4.3	–14.2	–2.2
	Large	0.8	1.8	–1.6	0.4	–0.2	–17	0.4
Loja	Small	4.8	–3.6	–0.6	0.1	2.4	1.3	5.1
	Medium	–9.1	–6.6	–2	0	1.5	–5.2	–2
	Large	–15.3	–7.7	–3.7	0.2	–2.6	–14.9	–1.5
Los Rios	Small	34.7	–0.9	12.9	–0.6	3	19.9	0.4
	Medium	9.3	–4.6	3.8	–0.3	3.2	37.6	7.2
	Large	7.4	3.5	4.7	0.1	–1.6	70.3	0.7
Manabi	Small	10.7	3.8	7.1	–0.5	3.3	2.2	–5.1
	Medium	–0.6	2.2	1	–0.5	1.6	3.6	–4.8
	Large	–5.2	–1.2	–2.9	0.2	–2.4	–6	1.1
Napo-Orellana	Small	18.9	9.8	7	0	–4.1	–1.9	8.1
	Medium	5.5	2.1	0.1	–2	–7.8	–6.1	13
	Large	–2.7	–5.4	–3.3	–0.7	6.1	–32.5	0.5
Pastaza	Small	–6.1	9.9	–17.5	–0.3	–9.9	3.6	8.2
	Medium	–6.5	5.8	–8.8	–2.5	–14.1	2.6	13
	Large	–2.2	–3.4	–4.5	–0.4	5.4	–43.6	0.7
Pichincha	Small	–24.5	5.6	–17.1	0.2	0.9	–5.7	–8.4
	Medium	12.7	15.6	–3	0.4	–1.2	–9.5	0.9
	Large	11.1	4.1	4.9	0.3	1.1	–5.7	0.8
Sucumbios	Small	31.5	11.2	7.3	–0.5	1	9.8	2.7
	Medium	6.2	–6	3.3	–1.1	–1	–3.8	11.1
	Large	–11.3	–6.8	–4.3	–0.7	–0.3	–34.1	0.8
Tumgurahua	Small	15.9	3.3	14.7	0.5	0.3	–5	2.1
	Medium	10.8	5.8	5	0.6	0.1	–10.7	–0.8
	Large	3.6	2.2	1.3	0.3	0.4	–15.2	–0.5
Undelimited areas	Small	5.2	–29.9	8.6	–0.7	3	16.3	7.8
	Medium	18.5	0.8	3.7	–0.2	1.2	31.1	13
	Large	8.1	1.4	6.9	0.2	–0.8	39.7	0.4
Zamora Chinchipe	Small	16.2	8	4.1	0.5	1.7	–1.1	3
	Medium	5.8	8.2	–2.6	–1.4	–2.2	–20.7	3.9
	Large	–9.2	–5.4	–3	–0.5	–0.8	–43.5	0.6

Source: Larson, León, and Mugai (2004), based on 2002 agricultural census data.

results indicate that, in practice, a large portion of observed productivity differences can be attributed to natural endowments and actions taken to mitigate associated natural risks. This is seen by examining the relative contributions of risk and nature in the last two columns. In some instances, markets also play a significant role, as do differences in household characteristics. Less significant are government programs that provide extension and credit, because, as discussed in chapter 5, few farms receive assistance through these programs.

However, for any regional development policy to be successful in terms of bringing good jobs to beneficiary territories, regional characteristics that can be affected by policy must matter for the determination of the number and quality of jobs. These issues are empirically explored in the following sections. While the evidence described thus far suggests that the sectoral and spatial rural development approaches are complementary, they do not prove that regional-level interventions can have the desired effects in terms of developing poor regions. The main reason is that

the studies reviewed above do not say much about whether regional characteristics that are policy-sensitive actually make a difference above and beyond changing individual or farm-level characteristics.

The necessary condition for regional policies to be effective is that regional characteristics must affect the welfare of its residents above and beyond the role played by their individual characteristics. In other words, if public policies, such as public education investments, raise the skills of farmers or other rural dwellers, this by itself can have positive effects in terms of poverty reduction, but it might lead to emigration of workers to urban areas, thus possibly reducing the effects on the development of local social and economic outcomes. Of course, even out-migration can have positive effects on the source communities (Taylor and Martin 2002). In fact, as discussed in Taylor et al. (2004), there is strong evidence suggesting that migration in Mexico is associated with improvements in Mexican rural household incomes. But this is the type of evidence that needs to be assembled to have firm grounds for supporting regional policies as opposed to focusing exclusively on national policies.

4.4 The spatial approach is promising: New evidence

This chapter's introduction mentioned that interest in the spatial approach has resurfaced in Latin America and the Caribbean since the early 1990s, partly in response to observed economic divergence across regions within countries. The combination of evidence of unconditional divergence with conditional convergence implies that the sources of regional divergence in countries are related to the spatial distribution of factors that determine economic development, thus producing so-called "convergence" clubs of territories with high and low development levels in countries. That is, rich regions tend to have better-educated workers, many of whom have migrated from poor rural areas, plus better governance, infrastructure, and so forth. At the international level, Easterly and Levine (2002) characterized this economic divergence driven by a confluence of factors as "when it rains it pours."

The evidence of conditional convergence across regions in countries is not sufficient to justify regional development policies, because the corresponding evidence is silent with respect to the effect of regional interventions. For instance, investing in education in one region might reduce national poverty without changing regional economic and social development patterns. For public education investment to have a chance of succeeding in raising living standards in local communities, local education levels must affect members' wages and employment opportunities, above and beyond what individuals can gain from raising their personal skills. If regional educational characteristics are not relevant for regional outcomes, then education should be pursued as a national welfare-enhancing policy rather than as a means of addressing regional inequities. This could be the case if, for example, educated workers migrate to regions where the returns to skills are higher, and thus regional policy will be unable to affect regional economic performance. However, if public investments in regional education lead to higher wages to workers with any given education level, then regional policies have a fair chance of success. The same logic applies to any public investment in regional public goods, including infrastructure development. This framework can be extended to noneconomic regional outcomes such as deforestation. Furthermore, national policies that change relative prices and the relative costs of accessing various domestic and foreign markets also have a chance of affecting a nation's economic geography as long as transport and other transaction costs matter for locational decisions by firms.

The following sections discuss new evidence about the determinants of job agglomeration in Argentina, Brazil, and Mexico, as well as regional patterns of wages in Brazil. Subsequently, we discuss new evidence concerning the development patterns in frontier territories in the Brazilian and Ecuadorian Amazon regions, which have additional implications for environmental policies and for socioeconomic development.

The spatial approach is promising: Latin American and Caribbean regional job agglomeration

Two studies commissioned for this report studied job creation dynamics across provinces or states in Argentina, Brazil, and Mexico. Sanguinetti and Volpe (2004) explored the determinants of manufacturing job agglomeration across Argentine provinces during 1974–94. Bravo-Ortega and Lederman (2005) studied the spatial patterns of employment agglomeration in Brazil and Mexico from the early 1980s to the late 1990s. Details about econometric techniques and data can be found in the corresponding papers. For the purposes of this report, it suffices to state that in the three cases the data come from employment or industrial surveys. The following paragraphs borrow heavily from the writings of these authors. Due to data limitations, the two studies did not analyze the same set of

explanatory variables or use the same econometric techniques, and thus we discuss the empirical evidence from each study separately.

Argentina[8]

In the case of Argentina, manufacturing industries have historically been unevenly distributed across provinces. One jurisdiction, Buenos Aires, accounted for an average of 44 percent of national industrial employment during 1974–94. Further, the five largest provinces (Buenos Aires, the City of Buenos Aires, Cordoba, Santa Fe, and Mendoza) have jointly accounted for more than 80 percent of total manufacturing employment. Although this spatial pattern did not change much during the 20-year period, there was a trend towards a de-concentration of industrial employment: the share of the five jurisdictions declined from 86 percent in 1974 to a bit over 81 percent of national manufacturing employment in 1994. These descriptive data suggest that economic reforms, especially trade reforms implemented beginning in the late 1980s, provided incentives for industries to locate themselves in regions that had not benefited from trade protection. In fact, the plethora of econometric evidence that Sanguinetti and Volpe discussed strongly suggests that, in fact, trade reforms were a primary cause of this process of de-concentration of industrial employment in Argentina. Thus the evidence suggests that in this case, trade policy has modestly helped address regional economic inequities.

Table 4.5 presents some results that Sanguinetti and Volpe provided. The results suggest that industries that use oil intensively in their production processes tended to locate themselves near sources of oil. In contrast, other variables that control for the interaction between regional characteristics in terms of their relative abundance of factors of production (skilled labor, labor, agricultural land, and so on) were not significant determinants of employment concentration at the provincial level. Likewise, industries that used transport services intensively did not show a propensity to seek localities endowed with good infrastructure as measured by the coverage of paved roads.

Regarding evidence that might support the predictions of so-called "new economic geography" discussed at the beginning of this chapter, the econometric evidence from Argentina is mixed. For example, Sanguinetti and Volpe report that industries with economies of scale (that is, measured by average number of workers per firm) did not settle in provinces with large consumption markets. This result could be driven by the fact that certain agricultural processing industries, such as those that process sugar and tobacco, tend to be large in size, but are located mainly in small northern provinces, such as Tucuman and Jujuy (which account for more than 70 percent of sugar-processing employment in Argentina), and Chaco, Misiones, Salta, Tucuman, and Jujuy (which account for roughly 60 percent of tobacco-processing employment). Thus there might have been some interaction between agricultural production and scale, rather than between scale and size of the local consumption market for each industry's products. On the other hand, there is strong evidence that manufacturing industries settle near the sources of inputs, as evidenced by the statistically significant effects of the interaction between a province's industrial base (measured by provincial shares in national employment divided by provincial industrial GDP) and the intensity of input use by each industry.

Perhaps more important for this chapter, trade policy did affect spatial patterns of manufacturing employment in Argentina. The interaction term between industry-level tariffs and geographic distance from Buenos Aires is negative and significant across all specifications, which implies that tariff reductions were associated with industry localization farther away from Buenos Aires.[9] Finally, provincial tax policies were also important for job availability: the negative and significant coefficient on the interaction between industrial promotion regimes that offered tax breaks to corporations and the industry's transport intensity suggests that mobile footloose industries, other things constant, are overrepresented in provinces with lower tax burdens. Similarly, the positive and significant interaction between the promotion schemes and economies of scale implies that industries with increasing return to scale move to favorable tax regions. Chapter 9 provides a more detailed discussion of specific policy options available to promote territorial job creation.

Brazil and Mexico[10]

As in Argentina, there is evidence that economic reforms have alleviated rather than worsened geographic inequities in Brazil and Mexico. Moreover, we also found strong statistical evidence indicating that certain types of RDPs have a chance of succeeding in these two countries. More specifically, the analyses discussed below suggest that policies targeting agriculture, education, and regional growth poles in Brazil have potential, whereas policies targeting education and industrial complexes are promising for Mexico.

TABLE 4.5

Determinants of industrial employment agglomeration in Argentina, 1974–94

Sample selection model (maximum likelihood estimation) – dependent variable: logarithm of locational shares									
Provincal characteristic	**Industry characteristic**	**(1) Ins**	**(2) Ins**	**(3) Ins**	**(4) Ins**	**(5) Ins**	**(6) Ins**	**(7) Ins**	**(8) Ins**
Agriculture abundance	* Agriculture intensity	–0.026	–0.038	–0.032	–0.032	–0.048	–0.044	–0.031	–0.030
		(0.021)	(0.022)*	(0.021)	(0.021)	(0.022)**	(0.022)**	(0.021)	(0.022)
Oil reserves	* Mineral intensity	0.112	0.103	0.090	0.089	0.090	0.092	0.090	0.090
		(0.054)**	(0.056)*	(0.054)*	(0.054)*	(0.055)*	(0.055)*	(0.054)*	(0.054)*
Relative wage	* Labor intensity	–0.012	0.001	0.002	0.003	0.002	0.001	0.003	0.003
		(0.067)	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)	(0.064)
Skilled labor abundance	* Skilled labor intensity	0.049	0.080	0.080	0.079	0.084	0.077	0.080	0.077
		(0.066)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)	(0.056)
Market potential	* Economies of scale		–0.357	–0.340	–0.342	–0.346	–0.344	–0.338	–0.337
			(0.059)***	(0.059)***	(0.059)***	(0.059)***	(0.059)***	(0.059)***	(0.059)***
Industrial base	* Industrial inputs intensity			0.144	0.140	0.145	0.142	0.140	0.139
				(0.034)***	(0.034)***	(0.034)***	(0.034)***	(0.034)***	(0.034)***
Industrial base	* Sales to industry				0.017	0.013	0.015	0.017	0.018
					(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Distance to Buenos Aires	* Tariffs	–0.203	–0.184	–0.150	–0.147	–0.150	–0.147	–0.147	–0.146
		(0.075)***	(0.074)**	(0.073)**	(0.073)**	(0.074)**	(0.074)**	(0.073)**	(0.073)**
Industrial promotion	* Transport intensity					–0.222	–0.232		
						(0.046)***	(0.045)***		
Industrial promotion	* Economies of scale							0.161	0.160
								(0.070)**	(0.069)**
Infrastructure	* Transport intensity						–0.048		–0.017
							(0.040)		(0.040)
Industry dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time dummies		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations		5890	5890	5890	5890	5890	5890	5890	5890
Wald test statistics (X^2)		7.81***	6.17**	6.72***	6.76***	6.77***	6.59**	6.66***	6.64***

Source: Sanguinetti and Volpe (2004), based on official employment survey data.
Note: Provincial characteristics are used in the selection equation. Robust standard errors in parentheses. * = significant at 10 percent; ** = significant at 5 percent; *** = significant at 1 percent.

Table 4.6 shows statistics that describe the evolution of employment concentration across states and industries of Brazil. The rank correlation coefficients show two interesting facts. First, there were no significant relative changes in the positions of the states according to their employment shares, and second, there were no important changes in the ranking of the industrial sectors and their labor demands. The indicators of the equality of employment opportunities across Brazilian states, the Gini index, and the corresponding Theil index over time suggest that, as was the case in Argentina, during the economic reform period, employment in Brazil became more evenly distributed than prior to the reforms. The share of the total employment inequality explained by differences across regions is also falling according to the Theil index.

Consequently, the share of inequality explained by the Theil index within-states component is increasing over time. The declines in the state Gini and the between-states Theil index are consistent with a decrease in the employment share in the top five states. This share falls from 34 to 25 percent. These facts, together with the results of the Spearman's rank correlation across states, imply that there was a change in the distribution shape, but not a change in ranking. Larger states experienced relative declines in their national employment shares as other states gained employment shares.

TABLE 4.6

Employment concentration in Brazil, 1986–99

	1986	1989	1993	1999
Top 5 states by employment share (percent)	Sao Paulo (24.8) Minas Gerais (10.9) Rio de Janeiro (10.6) Rio Grande do Sul (7.4) Bahia (7.2)	Sao Paulo (24.6) Minas Gerais (10.9) Rio de Janeiro (10.3) Rio Grande do Sul (7.1) Bahia (7)	Sao Paulo (22.7) Minas Gerais (11.3) Rio de Janeiro (8.9) Rio Grande do Sul (7.6) Bahia (7.5)	Sao Paulo (22.6) Minas Gerais (11.2) Rio de Janeiro (8.5) Bahia (7.6) Rio Grande do Sul (7.1)
Total employment share (percent)	61	60	58	57
Top 5 industries by employment share (percent)[a]	544 (10) 340 (9.4) 631 (5.5) 26 (4.8) 512 (4.2)	544 (9.1) 340 (8.5) 631 (5) 26 (4.3) 512 (3.8)	544 (8.4) 340 (7.8) 631 (4.6) 26 (4) 512 (3.5)	544 (7.5) 340 (7) 631 (4.1) 26 (3.6) 512 (3.2)
Total employment share (percent)	34	31	28	25
States rank correlation wrt T = 1986	1	0.999	0.987	0.986
States rank correlation wrt T – 1	—	0.999	0.986	0.998
Industry rank correlation wrt T = 1986	1	1	0.99	0.991
Industry rank correlation wrt T – 1	—	1	1	1
Gini coefficient by states	0.61	0.6	0.58	0.57
Gini coefficient by industries	0.89	0.81	0.72	0.68
Theil inequality index	1.75	1.67	1.7	1.66
Between-states inequality	0.64 (36.8%)	0.59 (35.3%)	0.56 (33%)	0.56 (33.6%)
Within-states inequality (weighted average)	1.1 (63.2%)	1.08 (64.7%)	1.14 (67%)	1.1 (66.4%)

Source: Calculations provided by Bravo-Ortega and Lederman (2005), based on official household survey data for Brazil (PNAD).
Note: — Not available. a. 544 = Domestic services (of any kind); 340 = Construction industry; 631 = Public education; 26 = Cattle industry; and 512 = Food services.

The data also show that the industrial Gini does change significantly over time, showing a decreasing trend. Furthermore, the Theil index within component explains an increasing share of total inequality. These facts, together with the results of the Spearman's rank correlation for industries, imply that there are sectors that are growing faster than others, but the top employment industries were the same over the period under study. Nevertheless, the Theil index implies that Brazil did experience an increase in the industrial specialization level in the Brazilian states.

Table 4.7 summarizes the Mexican experience and shows the descriptive statistics for Mexico. The rank correlation coefficients show two interesting facts. First, there is no significant relative change in the positions of the states according to their labor shares, but their labor demand with respect to total employment fell from 53 to 46 percent. Second, there are important changes in the sectors and their labor demands. While the list that composes the top five industrial sectors has changed over time, the total labor amount involved has not changed, averaging about 34 percent of the labor force.

In the data we observe that inequality among regions falls according to the Gini coefficient and the Theil index between components. According to the Theil index, the share of the total inequality explained by differences across regions is also falling. All these facts are consistent with the theoretical predictions already discussed. Consequently, the share of inequality explained by the Theil index within component is increasing over time. The fall in the state Gini and the between Theil index are consistent with a decrease in the employment share that corresponds to the

TABLE 4.7

Employment concentration in Mexico, 1985–98

	1985	1988	1993	1998
Top 5 states by employment share (percent)	D.F (22.4) Mexico (10.7) Jalisco (8.7) Nuevo Leon (6.2) Veracruz (5.2)	D.F (21.4) Mexico (9.8) Jalisco (6.8) Nuevo Leon (6.2) Veracruz (5.5)	D.F (19) Mexico (10.3) Jalisco (7) Nuevo Leon (6.2) Veracruz (4.8)	D.F (17.8) Mexico (9.8) Jalisco (7.4) Nuevo Leon (6.3) Chihuahua (4.9)
Total employment share (percent)	53	50	47	46
Top 5 industries by employment share (percent)[a]	6230 (10.4) 6210 (10) 6310 (5.9) 6120 (3.6) 8400 (3.3)	6230 (10.2) 6210 (9.5) 6120 (5.4) 6120 (3.7) 9510 (3.6)	6210 (11.3) 6230 (10.1) 9310 (6.6) 9510 (5.6) 6120 (4.1)	6210 (8.6) 6230 (8.4) 9510 (7.6) 9310 (5.6) 6120 (3.7)
Total employment share (percent)	33	32	38	34
States rank correlation wrt T = 1985	1	0.99	0.989	0.988
States rank correlation wrt T – 1	—	0.99	0.996	0.993
Industry rank correlation wrt T = 1985	1	0.926	0.838	0.778
Industry rank correlation wrt T – 1	—	0.926	0.945	0.971
Gini coefficient by states	0.55	0.53	0.5	0.49
Gini coefficient by industries	0.72	0.69	0.73	0.7
Theil inequality index	1.9	1.71	1.73	1.6
Between-states inequality	0.54 (28.7%)	0.49 (28.4%)	0.43 (24.8%)	0.41 (25.4%)
Within-states inequality (weighted average)	1.35 (71.3%)	1.22 (71.6%)	1.3 (75.2%)	1.19 (74.5%)

Source: Calculations provided by Bravo-Ortega and Lederman (2005), based on official industrial censuses.
Note: — Not available. a. 6230 = Retail non-food; 6210 = Retail food; 6310 = Non-food commerce; 6120 = Restaurants, bars, and night clubs; 9510 = Restaurants, bars, and night club; and 8400 = Services.

top five states. These facts, together with the results of the Spearman's rank correlation across states, imply that there was a change in the geographic employment distribution, but not a change in the state rankings.

The industrial Gini does not change significantly over time. Moreover, the industrial Gini coefficient and the within Theil index moved together over time. However, the within component of the Theil index explains an increasing share of total inequality, which is consistent with an increasing degree of specialization within Mexican states. These facts, together with the results of the Spearman's rank correlation for industries, imply that there are sectors that are growing faster than others, replacing them in their relative positions in terms of employment generation in Mexico. This fact can be noted by looking at the list of the top five industrial sectors. There, the professional services sector (9510) moves onto the list in 1988, ascending in its relative position and reaching the third spot in the list. In sum, the evidence is consistent with the predictions of the new economic geography literature discussed at the beginning of this chapter and with traditional trade theory: the data suggest that there is regional de-concentration of labor across the states and also some increasing degree of specialization within regions, both for Brazil and Mexico.

Tables 4.8 and 4.9 study the determinants of employment agglomeration in Brazil and Mexico. Bravo-Ortega and Lederman (2004b) discuss in detail the econometric challenges. The analyses for both countries looked at the impact of four types of regional characteristics: (a) past levels of employment shares for a given industry and for total national employment; (b) past education levels of the workforce in each state; (c) endowments of certain natural resources, including arable land; and (d) geographic distance from major consumption markets. In addition, the researchers examined the role played by the history of employment agglomeration of each industry in each state.

The first interesting difference between these two countries is that for Brazil, previous levels of overall employment concentration were significant predictors of current concentration of employment in a given industry, whereas in Mexico, the history of industry-specific concentration in each state helps predicts current employment creation. This

TABLE 4.8

Determinants of employment agglomeration in Brazil, 1986–99

Dependent variable: Change in share of labor employed in industry j in region r	(1)	(2)	(3)
Lagged change in employment share	0.0417	0.0478	0.0229
	(0.0166)**	(0.0463)	(0.0229)
Lagged change in regional employment share	0.6003	1.0682	0.3747
(all industries)	(0.1654)***	(0.1354)***	(0.1612)**
Change in share of regional skilled labor force	0.1353	0.1174	0.1426
	(0.0181)***	(0.0282)***	(0.0230)***
Log (agricultural land)	0.0003	0.0001	0.0014
	(0.0002)	(0.0002)	(0.0002)***
Share of mining production	–0.0216	–0.0255	–0.0262
	(0.0059)***	(0.0103)**	(0.0037)***
Log (distance to Sao Paulo)	–0.0011	–0.0039	
	(0.0006)*	(0.0010)***	
Log (distance to Buenos Aires)		0.0103	0.0065
		(0.0009)***	(0.0014)***
Constant	–0.0038	–0.0598	–0.0812
	(0.0044)	(0.0083)***	(0.0093)***
Observations	2477	2477	2477
Hansen's J test (p-value)	0.28	0.21	0.26
Consistency (p-value)	0.56	0.52	0.67

Source: Regressions provided by Bravo-Ortega and Lederman (2005), based on Brazil's official household survey data (PNAD).
Note: Robust standard errors are in parentheses. *** = significant at 1 percent, ** = significant at 5 percent; * = significant at 10 percent. Instrumental variables (IVs) are lagged levels of the endogenous variables. Regressions estimated with Arellano-Bond (1991) GMM estimator. Hansen's J statistic is a test of the null hypothesis that the correlation of the IVs with the errors is equal to zero. Thus a high p-value suggests that the IVs are valid. The consistency test is a test of whether the Arellano-Bond estimator is consistent with the hypothesis that time-invariant unobserved characteristics of industry-regions have constant marginal effects on industry-wage premia.

TABLE 4.9

Determinants of employment agglomeration in Mexico, 1985–98

Dependent variable: Change in share of labor employed in industry j in region r	(1)	(2)	(3)	(4)	(5)
Lagged change in employment share	0.3747	0.3777	0.2356	–0.0802	0.3769
	(0.1602)**	(0.1588)***	(0.1373)***	–0.2159	(0.1579)**
Lagged change in regional employment (all industries)	0.2721	0.2931	0.511	1.1114	0.288
	(0.2577)	(0.2598)	(0.2335)*	(0.2474)***	(0.2637)
D.log (years of education in each state)			–0.0179		
			(0.0224)		
Share of mining production		0.0002	0.0002	0.0001	0.0002
		(0.0001)*	(0.0001)*	(0.0001)	(0.0001)*
Log (agricultural land)		–0.0001			–0.0001
		(0.0003)			(0.0003)
Log (distance to DF)	0.0016	–0.0014	0.0013	0.0027	0.0014
	(0.0008)**	(0.0008)*	(0.0007)*	(0.0014)*	(0.0008)*
Log (distance to U.S. border)			0.0001		
			(0.0005)		
Telephone density					0.0000
					(0.0001)
D.log (scale)				–0.0024	
				(0.014)	
Constant	–0.0094	–0.0074	–0.0075	–0.0173	–0.0073
	(0.0048)*	(0.0057)	(0.0051)	(0.0090)*	(0.0063)
Observations	2126	2126	2126	1111	2126
Hansen's J test (p-value)	0.88	0.88	0.23	0.11	0.87
Consistency test (p-value)	0.99	1.00	0.67	0.15	1.00

Source: Regressions provided by Bravo-Ortega and Lederman (2005), based on Mexico's industrial censuses.
Note: Robust standard errors are in parentheses. *** = significant at 1 percent, ** = significant at 5 percent. * = significant at 10 percent. Instrumental variables (IVs) are lagged levels of the endogenous variables. Regressions estimated with Arellano-Bond (1991) GMM estimator. Hansen's J statistic is a test of the null hypothesis that the correlation of the IVs with the errors is equal to zero. Thus a high p-value suggests that the IVs are valid. The consistency test is a test of whether the Arellano-Bond estimator is consistent with the hypothesis that time-invariant unobserved characteristics of industry-regions have constant marginal effects on industry-wage premia.

effect disappears only when the average size of Mexican firms is considered in the analysis, which implies that there is a systematic relationship between industries and firm size. These results have important implications for the design of regional development policies in both countries: in Brazil, the economic poles approach might be more appropriate, whereas in Mexico, the key industries approach might be more relevant.

For Brazil and Mexico, the econometric evidence indicates that regional education matters for job creation. This result is consistent with theories that relate employment concentration to educational externalities or with the increasing need of firms for hiring educated workers. Regarding natural resource endowments, agricultural land favors employment generation in Brazil, but not in Mexico. Similarly, the total mineral production share appears to be negatively related to employment agglomeration in the case of Brazil.

For Mexico, we find that average firm size does not play a role in attracting employment to a given state. Moreover, the importance of distance to the Federal District declined during 1985–98, again demonstrating that trade reforms have diminished the importance of the country's traditional economic center. This result seems to come from a faster labor deconcentration across states than across industries, as can be noted from the evolution of the respective Gini coefficients presented in table 4.7. The opposite results are found for Brazil and the distance to Sao Paulo. In this case there has been a faster employment de-concentration across industries than across regions, as the Gini coefficients indicated (see table 4.6).

The distance to Sao Paulo has increased its importance as a determinant of job creation across regions and industries in Brazil (see table 4.8). This implies that Sao Paulo still acts as a pole of attraction for Brazilian firms. The previous results are interesting given the contrast between the Brazilian and Mexican experience, and they deserve further research on their own. It is plausible that trade liberalization has been stronger in Mexico than in Brazil, and thus different trade policies could be underlying explanations for these different experiences.

TABLE 4.10

Determinants of industry-regional wage premia in Brazil, 1985–99

Dependent variable: Change in industry-region wage premia	(1)	(2)	(3)	(4)
Explanatory variables:				
Lagged change in industry-region wage premia	0.3524	0.281	0.2467	0.2275
	(0.1853)*	(0.1562)*	(0.1265)*	(0.1257)*
Lagged change in share of skilled labor	2.1545	2.4784	2.5071	2.556
By state	(1.1651)*	(1.1490)**	(1.1294)**	(1.1293)**
Mining production share	0.1378	0.534	0.2885	0.4113
	(0.2589)	(0.2884)*	(0.2535)	(0.2704)
Log (agricultural land)	0.0088	0.0175	0.0322	0.0316
	(0.0164)	(0.0148)	(0.0141)**	(0.0139)**
Log (district Sao Paulo)		0.0568		0.0214
		(0.0127)***		(0.0108)**
Log (district Buenos Aires)			0.2285	0.1928
			(0.0544)***	(0.0561)***
Constant	–0.0853	–0.5864	–2.1646	–2.0176
	(0.2999)	(0.2967)**	(0.5629)***	(0.5666)***
Observations	445	445	445	445
Hansen's J test (p-value) &	0.04	0.11	0.20	0.22
Consistency test (p-value) &	0.25	0.56	0.66	0.69

Source: Bravo-Ortega and Lederman (2004b), based on official household survey data for Brazil (PNAD).
Note: Robust standard errors are in parentheses. *** = significant at 1 percent; ** = significant at 5 percent; * = significant at 10 percent. Instrumental variables (IVs) are lagged levels of the endogenous variables. Regressions estimated with Arellano-Bond (1991) GMM estimator. Hansen's J statistic is a test of the null hypothesis that the correlation of the IVs with the errors is equal to zero. Thus a high p-value suggests that the IVs are valid. The consistency test is a test of whether the Arellano-Bond estimator is consistent with the hypothesis that time-invariant unobserved characteristics of industry-regions have constant marginal effects on industry-wage premia.

Also from a practical policy viewpoint, the previously mentioned results regarding the regional job-creation effects of educational variables also highlight the promise of regional education policies. If combined with an open trade regime, it is likely that educational investment could lead to localized job creation in both countries, although they might still not be effective in creating employment in all regions, since factor endowments also seem to play a role in Brazil. As mentioned, there is also evidence suggesting that the economic poles approach needs to be taken seriously in Brazil, whereas the key sectors approach might be more effective in Mexico in terms of attracting employment to targeted regions. Finally, for Mexico, we did not find a significant impact of telephone density on employment creation, which by itself should keep us humble about the effectiveness of regional infrastructure policies in terms of helping create employment opportunities in laggard regions (see table 4.9). These policy issues are revisited in the next chapter of this report.

The promise of the spatial approach: Regional wages in Brazil

Thus far we have presented new evidence that suggests that under certain circumstances (namely, trade liberalization, special tax schemes in Argentina, and educational investments in Brazil and Mexico), regional-level interventions could effectively create employment generation centers. Here we examine the evidence concerning the promise of the spatial approach to raising wages. The evidence comes from Bravo-Ortega and Lederman (2004b), who studied Brazil's experience during 1986–99. The main finding is that Brazil's regional education policies can be successful in promoting regional wages, because regional educational levels affect the wages of workers regardless of their academic achievements. Also, the evidence suggests that the regional growth poles approach might be worth pursuing in Brazil, thus making this evidence consistent with the findings discussed above on regional job creation.

The first important finding of the regression results reported in table 4.10 is that Brazil experienced "conditional" convergence of wages across industries and states. This conclusion is based on the magnitude of the coefficient on the lagged wage premium. This means that if regional characteristics had been the same across Brazil, then the poorer regions would have experienced faster wage growth.

Regional-level education also seems to be an important predictor of wage premia. In this instance, it is noteworthy that these effects are strictly spillovers, since the estimation of the regional wage premia controls for the individual characteristics of workers. In other words, a worker of a given level of experience and education earns higher wages if he or she works in regions where the workforce has high average education levels. These results can be explained by positive externalities coming from more qualified workers to the rest of the local labor force.

Regarding the role of factor endowments, we found that regions with a higher share of mining production have increased their wage premia more than others. The evidence also suggests that agricultural land has a positive impact on wages. There is inconclusive evidence on the impact of industry concentration. Finally, an important finding is the declining strength of the wage gradient with respect to the economic poles of MERCOSUR, for either Sao Paulo or Buenos Aires. In turn, this decrease in a spatial wage premium gradient implies a geographical convergence of wage premia in Brazil as a whole.

The main policy implication of these findings is that the trade reforms in Brazil were associated with "conditional" convergence of wages across regions and industries. The fact that the expected geographic wage gradients became less strong also suggests that trade liberalization allowed regions farther away from the expected economic centers to provide better-paying jobs. In simple words, trade reforms stimulate wage improvements in geographically disadvantaged regions. Consequently, as trade reforms continue, infrastructure policies aimed at promoting high-paying jobs do not need to link geographic areas to the major demand centers as much as in the context of a closed economy. Rather, it is worth looking at infrastructure policies that link potentially viable economic regions to closer or local economic poles, as we already mentioned above. This is in fact the strategy that University of California at Berkeley's Alain de Janvry and others support.

Also from the viewpoint of other territorial development policies, the empirical evidence suggests that educational policies have a good chance to promote the emergence of high-paying job clusters. And discriminating against mining and agricultural activities might be self-defeating, as they do seem associated with increasing wage premia. Finally, we found little evidence of persistence of wage premia over time (that is, we found strong convergence in wage premia), which bodes well for the territorially focused policies in Brazil's development.

The spatial approach is promising: Patterns of frontier settlement in Brazil[11]

Some of the literature reviewed above, especially the economics of agglomeration, tells us that urban development is likely to be a critical factor in determining the benefits of opening new frontiers or developing certain regions within countries. It suggests that to empirically address the benefits of opening new frontiers in Latin America and the Caribbean, we need to take into account the relationship between pioneers' choice of economic activities and the aggregate effect of this choice on urban development. In particular, individual household decisions that in the aggregate result in low population densities and/or low multiplier effects may, in the long run, inhibit the region's growth potential. Areas where urban growth is depressed do not develop the innovation, learning, and links to global markets associated with urban agglomeration effects, nor do they tend to provide the options of nonfarm rural employment associated with higher density and urban development.

The evidence discussed in the following paragraphs suggests that key economic activities are associated with sustainable improvements in economic welfare, and the expansion of crop agriculture is associated with closer linkages with urban centers, higher average incomes of the relevant population, and less deforestation than livestock activities that require expansion of land to be used for pasture. On the one hand, these outcomes could be endogenous to preexisting regional characteristics (weather, soils, and preexisting infrastructure networks), but we believe that some of the observed patterns are due to exogenous variations that make these findings relevant for policy formulation: RDPs that aim to stimulate sustainable use of frontier forest lands should consider the potentially fruitful roles that can be played by key sectors (crop agriculture) and infrastructure investments that reduce the costs of geographic distance between the frontier areas and nearby urban growth poles.

The following sections examine patterns of frontier settlement and exploitation in the Brazilian Amazon regions. This case study is relevant for understanding the long-term consequences of policies that might lead to the settlement of low-population-density areas more generally. In addition, these experiences link the economic analysis of employment creation and wages with the complexities of environmental degradation, especially deforestation, which was previously analyzed in chapter 3 of this report, but mainly from the sectoral viewpoint.

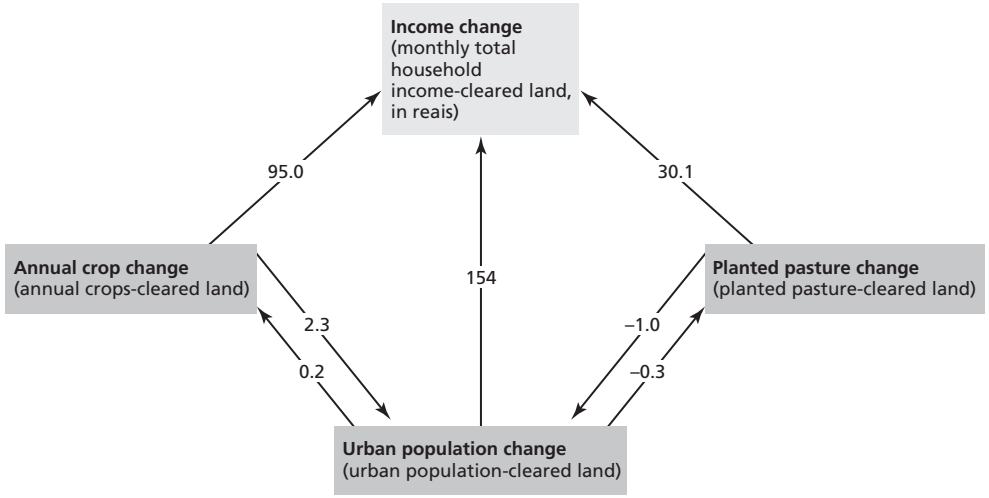
Influenced by the literature on rural nonfarm employment and the territorial approach to rural development (such as Andersen et al. 2002), Chomitz, Schneider, and Thomas (2004) investigated the interaction among rural activities, urban development, and the sustainability of regional incomes. Of particular relevance for policy discussions, the authors used a statistical technique (three-stage least squares [3SLS]) that allowed them to not only examine the effect of land use and population on income, but also to look at possible "feedback" effects of urbanization on land use and average incomes in the Brazilian Amazon frontier during the past 20 years. The existence of feedback effects produces path-dependent development, whereby initial conditions, such as soil quality and climate, lead to the selection of farming activities. In particular, these natural conditions provide the context in which settlers chose either to produce crops or cattle. Subsequently, the links with urban centers and/or the pace of urbanization produces income effects due to the emergence of economies of scale in transport and other factors that are critical for the productivity of agricultural and other rural economic activities. Figure 4.1 illustrates the main findings from the Chomitz, Schneider, and Thomas study.

The arrows depict the causal effects and the numbers provide the magnitudes of the estimated effects. For example, an increase of 1 percentage point in the share of cleared land that is used for pasture (cattle ranching) was associated with an increase of about 30 reais per household for each unit of land cleared. The effect of an analogous increase in the share of land cleared for crop production leads to an improvement in average incomes of 95 reais. Moreover, pastureland was associated with less urbanization: An increase of 1 percentage point in pastureland "caused" a decline of 1 percent in the ratio of urban population per unit of cleared land. In contrast, increases in cropland produced urbanization increases. In turn, urbanization itself increases incomes and increases cropland coverage. Thus frontier settlements that, due to natural conditions, resulted in the production of crops are associated with a virtuous cycle whereby cropland increases incomes and urbanization, which then leads to more cropland and so on. Pastureland, on the other hand, while it does modestly increase household incomes in frontier lands, tends to reduce the extent of urbanization, leading to less land dedicated to both crops and lands, thus resulting in subsequent negative effects on income.

This Brazilian frontier settlement case study clearly illustrates how certain regions in countries can fall into a "bad" equilibrium, depending on certain natural conditions combined with human actions undertaken in the course of history. Such cases can be found throughout the world and Latin America and the Caribbean is not an exception, and the phenomenon of the emergence of illicit crops in various countries and regions within countries is another example (see box 4.1).

FIGURE 4.1

Path dependency in Brazilian frontier settlements: Econometric evidence



Source: Chomitz, Schneider, and Thomas 2004.

BOX 4.1

The territorial approach to illicit crop eradication

The cultivation of illicit crops (namely coca and opium) remains a mystery to many. In fact, it remains a puzzle as to why more countries are not involved in the production of coca and opium, if the potential returns are so attractive (Thoumi 2003). The answer is not simple but may be attributed, in part, to plant varieties that thrive under specific conditions. It is also noteworthy that weak law and order and internal conflict characterize the major producers. Economic conditions might also be a relevant factor, for they determine the set of alternative economic opportunities for farmers.

Regarding natural conditions that can affect where illicit crops emerge, it is worth keeping in mind that the coca plant is commonly found throughout Latin America. But varieties containing the cocaine alkaloid (the basis for cocaine, HCl) are cultivated and converted primarily in Bolivia, Colombia, and Peru. It has been estimated that there are over 200 Erythroxylum (coca) species growing in the Western Hemisphere, but only 17 species can be used to produce cocaine. Fifteen of the 17 species contain relatively low levels of cocaine alkaloid, and thus are not cultivated. In South America, two species and two varieties in each of these species are cultivated and prosper under various climates. At the same time, the methods used to cultivate and harvest coca leaf differ depending on climate, local tradition, and other factors. The table above describes the various conditions in the Andean countries under which coca is cultivated.

Major coca regions in Andean territories

Country	Elevation (m)	Climate (F)	Rainfall (ft)	Region
Peru	600–1,911	55	12.44	Huallaga Valley
	730–1,300	53	1.32–5.94	Cuzco
	500–1,350	55	6.6–7.26	Ayacucho
Bolivia	1,465–1,830	45	4.00	Yungas
	200–550	57	13.00	Chapare
Colombia	1,000–2,050	49.5–52	5.00	Southern region: Putamayo, Caqueta, Guaviare, Vaupes

Source: Schaffer Library of Drug Policy, www.druglibrary.org.

The most widely grown coca variety is cultivated on the eastern slope of the Andes from Bolivia in the south to as far north as central Ecuador. This area of the Andes has a tropical climate and experiences high amounts of

While the unsustainable degradation of natural habitats can be quite costly (see chapter 3), the economic outcomes can be quite discouraging. From a policy viewpoint, we must consider approaches that safeguard the environment and offer alternative economic opportunities for poor families whose despair does not offer them the opportunity to internalize the long-run negative effects that their private actions can have on other community members and future generations.

4.5 Summary of analytical findings

This chapter posed a key policy question concerning the promise of public policies that aim to bring good jobs to particular regions within countries. Overall, the evidence is promising, because policy-sensitive characteristics do seem to affect both the quality and quantity of jobs available in territories in the confines of national borders. And these effects are regional effects in the sense that they come strictly from the regional traits rather than from the characteristics of people themselves. In other words, people's well-being can be affected by the regional characteristics above and beyond the consequences of individual characteristics. For example, for an individual worker's given education level, his or her wage will also depend on the educational characteristics of the community that surrounds him or her.

Yet these findings are a double-edged sword. That is, regional characteristics, such as soil types, climates, and even lack of law and order, can lead to poor developmental outcomes. The latter can have various symptoms, ranging from low incomes combined with environmental degradation (as in certain regions in Brazil's Amazon frontier) to the emergence of illicit crop cultivation in regions and countries where law and order is poor to begin with.

BOX 4.1 ***continued***

rainfall. Coca in this region is usually grown between 1,650 and 4,950 feet in elevation. Other varieties thrive in the drier regions of Colombia and, to a lesser extent, in República Boxlivariana de Venezuela. It is also grown at lower elevations where the climate is generally hotter. Coca is also found in western Brazil in the Amazon basin, southern Colombia, and northeastern Peru, but is primarily cultivated by indigenous populations for their own consumption and is not as high in cocaine alkaloids as that found in other areas. Thus it is unlikely that natural conditions alone explain the location of illicit crops.

As mentioned in chapter 3 of this report, governments around the world pursue policies that aim to eradicate or reduce the cultivation of illicit crops. These policies usually entail a mix of policies that are difficult to coordinate effectively. These include the spraying of pesticides over areas where illicit crops are located, the fight against the drug cartels that purchase and profit from these crops, and the implementation of alternative development projects.

In a very preliminary research paper, Lederman and Waite (2004) studied the empirical determinants of the probability of a country being an illicit crop producer. Consistent with the ongoing discussion, these researchers examined how the probability of being an illicit crop producer is related to natural, economic, and institutional factors. Their results from Probit econometric models suggest that economic activity and its composition predominate over natural conditions (that is, climate and elevation). Moreover, the RNR sector size is positively related to the probability of being a producer, whereas the non-RNR sector size reduces this probability. Thus it seems that the factors that determine a country's RNR sector size also promote the emergence of illicit crops. This is an intuitive result, since illicit crops likely use the same types of production inputs and use land as the main factor of production. Yet more developed countries, both in terms of GDP per capita and, alternatively, in terms of the quality of domestic institutions such as law and order, have a lower probability of producing illicit crops. While these are preliminary findings, they do at least suggest that regional characteristics that go beyond climatic and natural conditions determine the location of illicit and legal economic activities. In other words, legal economic opportunities (especially in non-RNR activities) reduce the likelihood that a region's workers will choose to participate in alternative illicit activities, while, in turn, law and order tends to promote the emergence of legal economic opportunities. This interpretation of the statistical patterns in worldwide illicit crop production is thus consistent with Thoumi's (2004) theory of competitive advantage in illicit activities.

In any case, the finding that regional characteristics matter for determining the development paths of regions within countries immediately calls attention to a long-standing debate in Latin America and the Caribbean over the appropriate design of territorial development programs. This debate is the subject of chapters 8 and 9 in this report.

Notes

1. This section draws heavily from Hewings (2003).
2. We thank Robert Schneider and Ken Chomitz for highlighting the similarities between the rural-urban linkages literature and the other concepts mentioned above.
3. See http://www.livelihoods.org/.
4. See http://europa.eu.int/comm/archives/leader2/rural-en/biblio/com-soc/pre.htm.
5. These projects typically provide money directly to local communities and let them decide what kinds of projects best meet local needs.
6. The errors are corrected to take into account the clustering effects generated by merging micro data with aggregate regressors. In our applications, a cluster is defined as a year-country combination.
7. This section draws heavily from Larson, León, and Mugai (2004).
8. This section borrows heavily from Sanguinetti and Volpe (2004).

9. The interpretation of this coefficient is as follows. Distance from Buenos Aires has a negative effect on employment agglomeration: the farther you are, the fewer jobs. The negative interaction tells us that as tariffs rise, the impact of distance becomes even more negative. When tariffs decline, the effect of distance becomes less important as the impact of distance becomes less negative.

10. This section borrows heavily from Bravo-Ortega and Lederman (2004b).

11. This subsection borrows heavily from research done by Chomitz, Schneider, and Thomas.

PART II

The Rural Contribution to Development: Policy Issues

CHAPTER 5

Public Expenditures, RNR Productivity, and Development

THIS AND SUBSEQUENT CHAPTERS ADDRESS SPECIFIC POLICY AREAS THAT SHAPE RURAL development's contribution to national welfare in Latin American and Caribbean countries. This part of the report thus covers policy issues related to the performance of RNR activities and issues related to the development of rural territories within countries. In other words, we cover policies that can be viewed through the lenses of either the sectoral or spatial approaches discussed in chapters 1–4. This chapter in particular covers topics related to the role of public expenditures in shaping the performance of RNR activities and national welfare. The focus gradually shifts to territorial development policies as the reader moves from chapter 6 to chapter 9.

More specifically, this chapter begins with an analytical evaluation of how public expenditures can be allocated across the rural and urban sectors to maximize the social benefits of scarce public resources. The main conclusion is that this allocation decision depends critically on two factors, namely the effectiveness (or efficiency) of public expenditures in lifting RNR or agricultural incomes and on the effect that RNR activities have on the rest of the economy. The latter was estimated in chapter 3, where we found that Latin American and Caribbean RNR activities make substantial contributions to national development to the tune of approximately twice the sector's GDP share. Thus the rest of this chapter turns to issues related to the impact of public expenditures on agricultural incomes and poverty.

Sections 5.2–5.4 study how the structure of public rural expenditures in Latin American and Caribbean countries affects agriculture and rural poverty. The main messages from our preliminary statistical analyses are that first, Latin American and Caribbean rural expenditures are severely hampered by excessive private subsidies offered to producers, thus reducing public investments in the provision of public goods that have salutary effects on the RNR sector. Second, there is a substantial underinvestment in rural areas and rural economic activities, which might be hampering primarily the emergence and growth of nonfarm economic activities.

Section 5.5 concludes this chapter by exploring how the provision of public goods, such as infrastructure, determines the productivity of land, labor, and capital used in the production of RNR products. We find that infrastructure, especially roads during the 1990s, were crucial for RNR productivity growth in Latin American and Caribbean countries. Nevertheless, we also find that there might be important differences across Latin American and Caribbean countries that require further analysis. This international evidence is complemented with detailed country case studies for Ecuador, Mexico, and Nicaragua. The evidence as a whole is quite strong in suggesting that the expansion of the agricultural frontier or the expansion of the size of land plots dedicated to RNR production does not necessarily raise productivity, which actually depends crucially on the availability of public goods and complementary factors of production.

5.1 National welfare and the allocation of public expenditures[1]

One of the key roles of central governments is to guide the allocation of public resources in the national economy. Policy makers usually face two broad types of motivations affecting allocation decisions. On the one hand, politicians have constituencies and interest groups, and voters permanently pressure them by seeking special favors from the public sector. On the other hand, policy makers are concerned about national welfare. This section provides a framework that identifies the key parameters that welfare-oriented policy makers need to know to assess whether the structure of public expenditures is optimal from a national welfare viewpoint. The focus is on the distribution of expenditures between "urban" and "rural" sectors of economic activity. The policy maker's challenge is thus to decide how to distribute the government's budget, G, into rural and urban expenditures, G_R and G_U, so that $G = G_R+G_U$. A simplifying assumption is that G is given prior to the allocation decision. So the policy decision affects only the distribution of G and is not related to the overall government size.

The welfare-oriented policy maker is concerned with maximizing national welfare, W, which is affected by the performance of the rural and urban sectors. In turn, public expenditures, G_R and G_U, are believed to positively affect the growth or size of these two sectors, although inefficient expenditures focused on providing private subsidies as opposed to public goods could hamper economic growth (see López 2004 and section 5.2). Thus, there are two relevant parameters: the sensitivity of *national welfare* with respect to sector performance and the sensitivity of sectoral performance with respect to sector public expenditures. The former was discussed in chapter 3, and thus the following subsection proposes a simple welfare-based rule for determining the marginal public expenditure's optimal distribution.

Welfare and optimal allocation of public expenditures

Suppose we have a utility function that has as arguments the size of the rural and urban sectors. Suppose, in turn, that the rural economy's output is a function of public expenditures in the rural economy. This welfare function can be written as follows:

$$W = W(R,U) = W\left(R(G_R),U(G_U)\right), \tag{5.1}$$

where W stands for national welfare, R represents rural economic activities, U represents nonrural activities, and the G's are sector public expenditures.

The policy maker aims to maximize welfare after the total public sector budget has been determined. Thus each expenditure unit dedicated to the rural sector comes out of the urban budget or vice versa. Hence the contribution of a marginal increase in G_R to W is the difference between the effects of G_R on W minus the forgone gains in W due to a reduction of G_U:

$$\frac{\partial W}{\partial G_R} = \frac{\partial W}{\partial R}\frac{\partial R}{\partial G_R} - \frac{\partial W}{\partial U}\frac{\partial U}{\partial G_U} = 0\,. \tag{5.2}$$

The policy question is how to allocate resources between rural and urban expenditures so as to maximize national welfare. In other words, the policy maker needs to find the optimal ratio between rural and urban expenditures. By adding the second term in (5.2) to both sides of the equation and then dividing both sides of the resulting equality by W, followed by some additional algebra, the optimal ratio of rural over urban expenditures becomes:

$$\frac{G_R}{G_U} = \frac{a_{W,R}\cdot a_{R,GR}}{a_{W,U}\cdot a_{U,GU}}, \tag{5.3}$$

where the a's are elasticities.[2] Equation (5.3) says that the ratio of rural over urban expenditures has to be equal to the ratio of the welfare elasticity with respect to each sector times each sector's elasticity with respect to the corresponding sector's public expenditures.

This is straightforward in theory, but complicated in practice. The reason is that a policy maker would need to have empirical measures of the relevant elasticities. For example, we need to know how rural development responds to rural public expenditures and how, in turn, national welfare responds to rural development (the numerator of the right hand side of equation [5.3]) and compare these estimates with those for the urban sector. This requires an empirical evaluation of the effectiveness of rural and urban expenditures and an understanding of how rural and urban development affects national welfare.

Bravo-Ortega and Lederman (2005) and chapter 3 provide regional estimates for $a_{W,R}$ and $a_{W,U}$, based on international data, but assuming that R is RNR output and U is non-RNR output. These authors also propose a national welfare function that goes beyond GDP per capita by assuming that national welfare also depends on the average

income of the poorest households, environmental outcomes, and risk. Moreover, since these authors estimate RNR's or rural growth's impact on national GDP per capita, this entails estimating cross-sector effects. That is, the authors estimate rural development's impact on urban development and vice versa. Thus their estimates of the sectoral welfare elasticities include not only the direct effects of the rural and urban sectors on welfare, but also the indirect effects via their influence on each other.

Estimating these parameters or the efficacy of rural and urban expenditures remains a subject for future research. The following section discusses the relationship between this general welfare approach to allocating public expenditures and a commonplace technique used for assessing the sector biases of public expenditures, namely the so-called "benefit incidence" analysis of such expenditures.

Welfare and benefit-incidence analyses

Informed analyses of the sector distribution of public expenditures often use the so-called "benefit incidence" approach. This data-intensive approach requires household surveys that contain data on transfers and in-kind services received by rural and urban households. It is common to see this application in analyses of what portion of public expenditures is received by rural and urban populations, usually focusing on poor households (see, for example, Scott 2004 on the Mexican case).

This approach is a special case of the more general welfare approach. First, the focus on the value of public expenditures received by poor households entails a poverty-focused national welfare function. That is, the analyst implicitly assumes that national welfare is synonymous with the welfare of poor households and that the latter depends exclusively on the pecuniary value of income sources, including the value of transfers and in-kind goods and services that the government provides. Second, the benefit incidence approach implicitly relies on the assumption that each dollar or peso spent in rural and urban areas has the same rate of return in terms of poverty reduction.[3] Consequently, the traditional benefit incidence approach portrays a rural bias in public expenditures whenever the value of public-sector transfers and services received per rural poor is larger than that received by the average urban poor.

Although the benefit incidence approach is informative and is superior to no empirical counterpart to the political decision of how to distribute public funds across sectors, it is worthwhile to be explicit about this approach's limitations. The most important one is related to the second issue raised in the previous paragraph, namely the assumption that the rates of return (in terms of reducing poverty) are the same across sectors. This is important because it is expected that delivering social services is generally more expensive per beneficiary in rural areas, where population density tends to be lower than in cities. Thus higher unit costs in the delivery of services might be driving findings of higher public expenditures on the rural poor than on the urban poor. This does not mean that policy makers should ignore the costs, but rather that the benefit-incidence analysis might be strictly driven by costs instead of social benefits. The following section examines another common and related methodology used for allocating public expenditures.

The sector shares approach

Conventional wisdom dictates that governments should distribute their expenditures according to each sector's share in the national economy. This view is also a special case of the general welfare approach. First, it presumes that each sector's marginal contribution to national welfare is equal, which would justify using sector shares as benchmarks for the distribution of national expenditures. Second, this approach implicitly uses the assumption that the marginal contributions of public expenditures to each sector are also equal.

It is noteworthy that the sectoral shares approach is identical to the benefit incidence approach when poverty is the target in the national welfare function. If the policy maker is concerned only with reaching the poor, then allocating public expenditures so that each poor family, whether rural or urban, receives the same amount of benefits is the same as allocating expenditures according to the share of poor families found in each sector.[4]

Can we do better?

Thus the question is whether welfare-oriented policy makers can do better than the benefit-incidence or the sector shares approaches. Again, in theory they can do much better, but this requires knowledge about the effectiveness of rural and urban expenditures, as well as a broader view of national welfare. In turn, this requires rigorous evaluations of the impact of various public expenditures on each sector's welfare. In the case of a poverty-focused welfare function, this requires knowing how effective sector-specific public expenditures are in reducing poverty, beyond the value of benefits that private agents or households receive. That is, it

requires knowing the marginal social returns of such expenditures. The following section sheds some light on these issues.

5.2 Are there policy biases in Latin American and Caribbean countries against rural development?

Policy biases against rural development come in the form of a pattern—across regions and economic sectors—of government expenditures on infrastructure, social services, and subsidies, and of trade and price policies. The issue of trade policy and its effect on agriculture specifically is treated in some detail elsewhere.[5] This section examines two factors associated with a policy bias against rural economic activities, with a special focus on RNR activities: the level and mix of public expenditures and the role of urban concentration. First, we address the hypothesis of the underprovision of public goods in rural areas, examining first the mix then the level of public spending.

Why worry about the provision of rural public goods?

The underprovision of public goods may have important consequences for the productivity of private investments. Expenditures on public goods create assets that are complementary with private capital, and an absence of such expenditures would both affect the scarcity of human capital[6] and result in the underinvestment in a variety of socially beneficial projects: R&D, infrastructure, environmental protection, and so on (World Bank 2000). These are important assets that contribute to the productivity of private investments, and their absence or deficiency would constitute an obstacle to economic expansion.

Government expenditures are directed toward a mix of public and private goods. The bias in the mix toward one type of good or the other not only has efficiency implications, but may have important *equity implications* as well. Government expenditures in (nonsocial) subsidies and other private goods tend to be directed to the wealthier segments of society, sometimes to the detriment of the poor. The levels of taxation that accompany the expense of private goods also have negative equity consequences in countries that rely heavily on indirect taxation.

Furthermore, the undersupply of public goods affects the welfare of the poor much more than the welfare of the wealthy. This is particularly important for the rural poor because they have few assets beyond their labor and perhaps their land and their access to natural resources. Consequently, the rural poor's income is sensitive to their ability to enhance their human capital and to protect their natural assets; from society's perspective, both have characteristics of semipublic goods and both are influenced by expenditures on social goods.

The performance of agriculture and the evolution of rural poverty are likely to depend on economic interdependencies with the rest of the economy and with the rest of the world. Much of the direct interactions occur through mechanisms associated with trade and marketing interventions and with public expenditure levels and composition in the rural sector. In addition, both agricultural productivity and rural poverty may be affected by the nonrural economy's performance, as discussed in chapter 3 of this report and also analyzed in Gardner (2002). A dynamic nonrural economy may have positive spillover effects on the rural sector and agriculture through higher farm product prices, the greater availability of credit, and new technologies. In addition, better employment opportunities and higher economywide wages are likely to also have positive influences on rural poverty through both migration to and remittances from urban sectors.

The manner in which the government spends tax revenues in the rural sector—the particular mix of goods—is often insufficiently emphasized and analyzed in the literature. The classification of public expenditures into *public* (or semipublic) goods and *private* goods arises from the conceptual view that governments should use the taxpayer's money to enhance social welfare by providing goods and services that are undersupplied as a consequence of missing markets or market imperfections. While there are some gray areas in characterizing whether a good is public or private, in practice more often than not the distinction is quite sharp. Notwithstanding the debate regarding whether or not governments spend enough in rural areas or on agriculture,[7] the *structure* or composition of expenditures in rural areas (including, of course, in agriculture) in terms of public versus private goods is often overlooked.

Subsidies and agricultural performance

Investment in public goods provides factors of production that, almost by definition, the private sector rarely supplies, although there is often a complementary relationship between public goods and private investments. Government expenditures in private goods and subsidies, by contrast, finance assets with returns that private interests capture. The effect of these subsidies is almost always detri-

mental to economic efficiency and growth and, instead of contributing to the promotion of private investment, sometimes they tend to crowd them out, simply increasing the consumption of the wealthy.

The public provision of private goods or subsidies has two negative effects. First, it displaces investment in public goods. Government subsidies compete with the provision of public goods, not only in terms of financial resources, but also in terms of other scarce resources. The administration of subsidy programs often absorbs a large share of limited human capital, and scarce institutional capital is often preferentially allocated to such programs. Subsidies directly crowd out financial and nonfinancial resources available to governments that could otherwise be used to fund the provision of public goods, such as R&D expenditures or infrastructure investments.

Second, subsidies reduce the efficiency of private investments. The existence of subsidies alters incentives for investments that are privately (and socially) profitable and can divert private investments toward activities that would otherwise not be privately profitable. Several studies in various countries have shown that subsidies, at least in the form in which they are usually allocated, do not generally promote investment or more R&D. Empirical studies using detailed firm-level data have shown that subsidies and corporate tax concessions are at best ineffective at promoting private investment and technological adoption.[8] Furthermore, subsidies also hamper the long-run efficiency of private investment, because the public expenditure biases toward subsidies are usually long-run in nature. The low stocks of public goods caused by continuous underinvestment lower the productivity of private investments over the long run, which is translated into slower investment and slower productivity growth.[9]

The structure of public expenditures and rural poverty

Two important components of rural public goods are human capital and investment in the protection of natural resources and the environment. Human capital is the main productive asset for most poor. As a consequence of credit and other market failures, however, in general, the poor are not able to fully finance investments in human capital, regardless of how high the rate of return on these investments might be (World Bank 2000). They are, therefore, largely dependent on the public sector as a source of financing for these investments.[10] Moreover, the rural poor are also highly dependent on natural resources as a source of subsistence (Barbier 2004). The rural poor often disproportionately pay for resource degradation; investments to protect natural resources and reduce environmental externalities are a means to alleviate rural poverty.

An inadequate stock of rural public goods contributes to slower growth for agriculture and related rural industries. In general, much of the rural industry linked to agriculture is highly intensive in unskilled labor, which is the principal resource of the poor (as shown in the studies for Chile and Mexico), and in many developing countries the rural sector's share in the unskilled labor market is sufficiently large to influence significantly the real wages for unskilled workers at the national level. A growing rural sector is a source of employment for unskilled workers and plays a role in raising wages; consequently, it is a source of poverty alleviation.

Econometric evidence of the importance of the expenditure mix in rural areas in Latin America

One method to ascertain the importance of the mix of government expenditures on the rural sector is to estimate its relationship to countries' agricultural GDPs per capita of their rural populations. Using data from several Latin American countries on total government expenditures in rural areas and the share of those expenditures in private goods or subsidies, López (2004) estimates this relationship controlling for trade openness and the per capita GDP share of the non-agricultural sector. The basic data on government expenditures in rural areas are available for 10 Latin American and Caribbean countries for 1985–2000.[11] Public goods expenditures include those on technology generation and transfers, soil conservation, sanitary and phytosanitary protection, communications and information services, rural infrastructure, and social services (for example, education and health). For private goods, expenditures include commodity-specific or focalized items, marketing assistance and promotion, subsidized credit, and irrigation.

Table 5.1 summarizes the data on rural expenditures in terms of yearly average expenditures for three five-year periods. On average, across the nine countries for which data are available, between 1985 and 2000 more than 54 percent of total rural expenditures was on private goods. But the level and composition of government expenditures has changed significantly over the period. The share of spending on private goods (subsidies) has declined notably

TABLE 5.1

Government spending in rural areas in Latin America, subsidies and total expenditures (millions of U.S. dollars), 1985–2000

	1985–89		1990–94		1995–2000	
Countries	Subsidies	Total	Subsidies	Total	Subsidies	Total
Costa Rica	7.5 (33.3%)	22.5	34.0 (29.3%)	116.2	31.7 (24.8%)	127.6
Dominican Republic	164.0 (74.1%)	221.4	183.8 (75.4%)	243.8	162.0 (47.7%)	339.8
Ecuador	59.7 (60.2%)	99.2	67.8 (65.9%)	102.8	123.3 (78.0%)	158.1
Honduras	0.7 (9.0%)	7.4	2.0 (13.9%)	14.1	7.7 (10.3%)	74.7
Panama	109.5 (84.4%)	129.7	51.5 (78.8%)	65.4	75.9 (63.3%)	119.8
Paraguay	72.7 (75.5%)	96.2	110.3 (79.2%)	139.3	111.1 (78.4%)	141.7
Peru	37.8 (63.5%)	59.5	288.1 (65.1%)	442.5	250.4 (43.3%)	578.2
Uruguay	7.3 (20.9%)	35.1	6.7 (16.7%)	39.9	8.4 (19.3%)	43.5
Venezuela, R.B. de	485.7 (53.3%)	910.5	176.3 (41.4%)	425.8	95.2 (27.0%)	352.9

Source: López (2004), based on data from the FAO Latin American and Caribbean regional office in Santiago, Chile.

for most countries, and across all countries fell from 60 percent for the five-year period 1985–1990 to 44 percent for 1995–2000. Only for Paraguay has the share of subsidies increased substantially.

Agricultural growth impact

The López results distinguish between "long-run effects" of the mix of government rural expenditures, derived from panel-data estimation using the five-year averages, and "short-run effects" that make use of the data for individual years.[12] The most important message emerging from these estimates is that, while government expenditures also have a positive effect on agriculture per capita income, the structure or composition of such expenditures is very important. In fact, the results show that, while the short-run effects are smaller, the long-run marginal effect on agricultural GDP per capita of the share of subsidies in total expenditures (holding total expenditures constant) is surprisingly large and negative (and highly statistically significant): a reallocation of 10 percentage points of total public expenditures from subsidies to public goods would increase per capita agriculture income by about 2.3 percent. And this is obtained *without* increasing total expenditures. By contrast, increasing government expenditures (without changing their composition) is much less effective in raising per capita agriculture incomes: a 10 percent expansion of government outlays causes on average only a 0.6 percent increase in agriculture income. These impacts are large mainly because they capture both the positive effect of increasing the provision of public goods and the positive effect of reducing the distortions created by subsidies, which negatively affect the quantity and quality of private investment, as mentioned above.

In 1996–2000, the 50 percent of the countries that spent the least in rural areas spent about $35 per capita, while the top 50 percent of the countries spent about $74 per capita. If a representative country of the lowest spenders in the region (in terms of per capita expenditures in rural areas) were to spend like the representative highest spender in a region, per capita agricultural GDP would increase by 3 percent. With respect to the share of subsidies in 1996–2000, it ranged from approximately 30 percent average for the bottom half to 65 percent for the top half. This means that if the representative (average) country of those that subsidize private goods the most were to readjust its expenditure shares to the level of the representative country of those that subsidize private goods the least, its agricultural GDP per capita would increase, ceteris paribus, in the long term by a substantial 12.5 percent.

Poverty reduction impact

Although econometrically there is no statistically significant direct effect on poverty from the level and mix of government expenditures (due in part to a lack of rural poverty data), there is statistically robust evidence that growth in RNR GDP contributes to alleviating rural poverty. Marginal changes in non-agricultural GDP also reduce rural poverty rates, but the size of their effect is more modest. The public expenditure level and structure have important effects on agriculture per capita income and so have indirect effects on poverty that are significant. Based on the López estimates, a 2.3 percent increase in agricultural GDP per capita (due to a 10 percentage point reduction in the share of private good spending) would, in turn, induce a 1.2 percent reduction in rural poverty. Using the 1996–2000 averages for the highest and lowest subsidizers, if the expenditure share on subsidies decreased from 65 percent (the average for the highest) to 30 percent (the average for the lowest), poverty would decrease 4.2 percent. Supposing that 30 percent of the rural population is living in poverty, with this change in expenditure shares, this poverty rate would decline to 28.7 percent.

This econometric analysis suggests that the structure of public expenditures is an important economic development factor, and the quantitative importance of this factor appears to be greater than the traditional factors that the development literature focuses on. In particular, expanding total public expenditures in rural areas while maintaining the existing public expenditure composition does little to promote agricultural income and reduce rural poverty. The key issue is not so much how much money is spent in the sector, but rather how public monies are being spent.

The Latin American and Caribbean evidence with respect to the spending mix is supported by other studies, both country-specific and using cross-country analysis. In a detailed study of India, Fan, Hazell, and Thorat (1999) find that spending on rural roads and agricultural research and extension has large poverty-alleviation effects and, compared with other farm-related expenditures, the largest impact on agricultural productivity growth.

In a cross-country study of the effects and determinants of government spending patterns in 43 developing countries, Fan and Rao (2003) find that, with respect to agricultural GDP, in general, spending on programs and investments related to production agriculture and on education and roads promoted the sector's output. And more important for the mix of government expenditures related to agriculture, R&D outlays enhanced the sector's productivity more than nonresearch spending. With respect to the influence of government spending mix on national economic growth, the cross-country evidence is less clear. The marginal effects of all types of expenditures were positively correlated with growth in Asia, and in Africa spending on health and the farm sector were significant in promoting total growth. For Latin America and the Caribbean, however, the Fan and Rao empirical work finds that only health spending contributed to growth. This could be due to the inefficient structure of Latin American and Caribbean rural expenditures, as mentioned above.

5.3 Disparities in the per capita spending level in urban and rural areas

The evidence of extremely high and nondeclining rates of return suggests that there are important Latin American and Caribbean investment opportunities in public goods that are not being exploited. An immediate question is, why? Many development economists have pointed to the history of bias toward urban areas in national plans to account for an insufficient level of public investments—and slower growth—in agriculture and rural areas.[13] This supposed bias is manifested both in terms of the large differences between government expenditures per person on social services in urban and rural areas and in terms of the discrepancy between outcomes, such as measured by health and education levels. Certainly, the data available suggest a large discrepancy in both spending and outcomes: compared with national averages, rural areas receive far fewer central government resources per person for education (see table 5.2), and their educational attainment levels are typically lower and school dropout rates higher (see table 5.3).

Distortions in public expenditures on social services and infrastructure between urban and rural areas would have consequences for the marginal productivities of human capital and other factors in those areas. In the case of education specifically, human capital formation would be influenced by both the supply of education services (the number and quality of schools) and the demand for those services. Schooling demand is driven, in part, by the potential returns to human capital in economic activities in rural areas (and in urban areas for potential migrants), which is influenced by other public investments. The terms of trade between rural and urban areas are determined in part by sectoral and trade policies that are not directly related to expenditures on social services.

TABLE 5.2

Central government expenditures on education both in rural areas and nationally (U.S. dollars per person)

	1995	1996	1997	1998	1999	2000	2001
Money spent on education in rural areas							
Bolivia	2.6	6.1	4.3	3.5	4.0	3.5	—
Chile	34.4	47.5	43.2	20.5	18.9	60.1	—
Colombia	0.3	0.3	0.3	0.4	1.5	—	—
Dominican Republic	15.5	19.3	22.7	31.9	38.3	48.3	52.9
Ecuador	3.2	2.5	2.0	2.7	2.9	2.6	10.0
El Salvador	0.0	20.7	26.0	29.8	32.6	36.3	—
Panama	—	—	—	0.1	—	—	0.8
Paraguay	1.5	1.8	1.9	1.7	0.8	0.3	0.7
Peru	7.3	3.7	6.6	2.6	5.6	0.1	1.2
Uruguay	1.0	1.0	1.2	1.3	1.3	1.3	1.4
Venezuela, R.B. de	11.9	8.0	13.6	15.1	17.4	34.6	30.1
Money spent on education nationally							
Argentina	265.0	288.0	—	334.0	350.0	304.0	
Bolivia	52.0	47.0	—	59.0	57.0	56.0	
Brazil	220.0	—	—	—	156.0	167.0	
Chile	136.0	156.0	181.0	184.0	201.0	208.0	
Colombia	74.0	87.0	—	—	—	—	
Costa Rica	115.0	131.0	—	—	196.0	174.0	
El Salvador	36.0	41.0	47.0	46.0	47.0	—	
Guatemala	25.0	25.0	—	25.0	26.0	29.0	
Mexico	—	—	—	185.0	218.0	—	
Nicaragua	13.0	13.0	15.0	21.0	—	—	
Peru	—	73.0	—	73.0	68.0	—	

Sources: FAO Regional Office, Santiago, Chile, and World Bank 2003a.
Note: — = Not available.

TABLE 5.3

Percentage of students reaching three levels of mathematics proficiency, and primary school dropout rates, rural and urban areas

	Urban				Rural			
Country	Level I	Level II	Level III	Dropout rate, primary school	Level I	Level II	Level III	Dropout rate, primary school
Argentina	96	54	11	—	94	43	6	—
Bolivia	94	51	14	2	89	36	8	10
Brazil	94	55	15	5	84	40	7	4
Chile	95	52	12	4	87	38	6	12
Colombia	93	43	6	6	92	50	12	21
Cuba	99	90	76	—	99	89	72	—
Dominican Republic	81	36	4	4	79	38	7	2
Honduras	86	39	8	32	78	23	13	57
Mexico	94	58	13	10	90	46	10	24
Paraguay	88	42	9	16	82	34	8	36
Peru	89	33	4	21	78	23	2	21
Venezuela, R.B. de	77	27	3	5	68	22	2	5

Source: UNESCO (2001) Informe Técnico del primer estudio internacional comparativo, August 2001.
Note: Dropout rates from Panorama Social de América Latina, CEPAL, 2001–2. Primary school is defined as grades 1–8. — Not available.

Relative to urban areas, a policy bias against rural areas lowers incomes reduces the demand for education, which is available in fewer and lower-quality schools. The end result is a tendency for lower rural incomes to persist, and for a reduced demand for education. But studies suggest that the impact of lower human capital formation in rural areas goes beyond the income generation potential of individual households. Using panel data of 65 developing countries throughout the world (including 19 in Latin America), Chai (1995, cited in Timmer 2002) finds that the urban policy bias reflected in relative educational outcomes in rural and urban areas has an important impact on national economic growth as well.

A crude measure of the possible bias against rural areas in government expenditures is the share of rural expenditures in total, relative to agriculture's share in national GDP, the most important rural industry. This index of government expenditures in rural areas is the ratio of two proportions: the rural sector's share of total spending *(G_R/G),* and agriculture's share of national GDP *(GDP_A/GDP_T):*

$$IGER = \frac{G_R / G}{GDP_A / GDP_T}. \qquad (5.4)$$

When the index is equal to one, a government is spending proportionally in rural areas what agriculture is generating as a share of national income. This index is a broad gauge of how close public spending is to meeting the criterion that governments should distribute their expenditures according to each sector's share in the national economy. As discussed in section 5.1 above, such an objective would only be consistent with optimizing national welfare under very special circumstances. In fact, the evidence assessed in chapter 3 suggests that Latin America and the Caribbean's average welfare elasticity with respect to agriculture is roughly equal to two times its share in national GDP.[14] If the sectoral returns to public expenditures are equal for rural and urban expenditures, also an unlikely proposition unless the structure of rural public expenditures is improved in most Latin American and Caribbean countries as argued above, then the optimal *IGER* would be equal to 2. Nevertheless, using this index of relative proportions of spending to sectoral GDP, one can compare the implicit weights that *governments* place on their rural sectors across countries and through time.

Table 5.4 shows the evolution of these indices of all government expenditures in rural areas for 10 Latin American countries for which data are available between 1985 and 2000. What is notable from these data is the heterogeneity of the spending index across countries. The indices indicate that for several countries, in the latter half of the 1990s, rural areas received more than the share of agriculture in the total economy. This is the case of Chile, the Dominican Republic, Honduras, Panama, and República Bolivariana de Venezuela. (But remember, an index value of one is not a reference point for social efficiency.) For the other half of the countries, rural areas receive less than the agricultural GDP share. Aside from an increase in most countries in the spending index in the late 1990s compared with the mid-1980s and early 1990s, there is no general pattern for the region. In terms of *total* spending on all types of goods,

TABLE 5.4

Index of government expenditures in rural areas: Share of rural outlays in total spending relative to the share of agricultural GDP, 1985–2000

Country	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Chile	—	—	—	—	—	—	0.83	1.37	1.58	1.27	1.12	1.26
Costa Rica	—	0.13	0.17	0.92	0.87	0.78	0.61	0.65	0.68	0.46	0.39	0.52
Dominican Republic	1.94	2.56	3.48	5.63	3.42	3.45	2.69	2.25	2.06	2.25	2.31	2.32
Ecuador	0.03	0.05	0.04	0.04	0.04	0.01	0.03	0.04	0.03	0.02	0.04	0.02
Honduras	0.09	0.05	0.13	0.15	0.25	0.13	0.32	0.39	0.41	0.65	0.79	1.61
Panama	1.32	0.44	0.62	0.58	0.67	0.56	0.64	0.65	0.77	1.50	0.99	1.23
Paraguay	0.10	0.82	1.20	—	0.89	0.69	0.85	0.76	0.79	0.59	0.45	0.51
Peru	0.25	0.88	1.21	0.80	1.81	1.48	1.50	1.26	1.32	1.06	0.87	0.67
Uruguay	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Venezuela, R.B. de	2.65	1.13	1.36	1.61	1.06	0.82	0.92	0.92	1.31	1.00	0.88	1.37

Source: Calculated based on FAO rural government expenditure data; GDPs from World Bank 2003a.
Note: — Not available.

there does not appear to be a systemic bias against rural areas across Latin American and Caribbean countries. But given the evidence presented earlier, there is very likely a systematic bias in the provision of public goods, such as education and infrastructure investments.

5.4 Does excessive urban concentration harm RNR activities and the rural economy?

Latin American and Caribbean urbanization levels are high in comparison with other regions and similar to those of North America (see table 5.5). The regional average of the percentage of the population living in urban areas is currently 75 percent, and by the year 2025, average urbanization is projected to reach 82 percent (reported in Lattes, Rodríguez, and Villa 2002). Recently growth rates in the region's urbanization levels have declined (0.8 percent between 1975 and 2000), compared with the period between 1925 and 1950, when the urban growth rate (2 percent) was twice that of total population growth.

Historically, Latin America has been notably urbanized relative to its degree of economic development. This characteristic is sometimes attributed to the initial conditions associated with the Spanish colonization process (for example, in Lattes, Rodríguez, and Villa 2002), to the emphasis on primary production for export (and the consequent growth of port cities) prior to the early twentieth century, and later waves of immigrants to urban centers from outside the region (Lattes, Rodríguez, and Villa 2002). The period of import substitution policies, which promoted urban industry prior to trade reforms, has also been implicated in the rapid expansion of regional cities after 1925 (Cerrutti and Bertoncello).

Although it has been the case that, worldwide, the number and size of urban areas have increased with population increases, certainly the growth of large cities in Latin America has been striking, as can be seen in table 5.6.

In 1950, 16 percent of South America's urban population lived in cities of more than 500,000 and nearly 13 percent in cities of greater than 1 million, of which there were only five. By contrast, in 1990 nearly 38 percent of the urban population lived in cities of more than 500,000, and 32.5 percent lived in cities of more than 1 million, of which there were 31. Moreover, while in 1950 South America could claim only one city of more than 4 million, in 1990 there were six.[15] The number of South American urban areas of greater than 20,000 inhabitants grew from 194 in 1950 to 931 in 1990, and in Mesoamerica from 77 to 279.

Although the region as a whole can be characterized as highly urbanized if official criteria are used, the degree of urbanization varies significantly across countries (see table 6.8). In South America, Argentina had the largest percentage of urban residents in the year 2000 (90 percent) and Paraguay the smallest (65.3 percent). In Mesoamerica, Cuba ranked highest in degree of urbanization (75.3 percent) and Haiti and Guatemala the lowest (36 percent and 40 percent). The degree of urban primacy (the percentage of total urban population living in the largest city) also varies in the region, from Panama and Guatemala with over 70 percent of their urban populations in the largest city, to Brazil and República Bolivariana de Venezuela with about 15 percent urban primacy. In general terms, the smaller countries of Mesoamerica have the highest urban primacy

TABLE 5.5

Regional urbanization levels (percent), 1925–2025

Region	1925	1950	1975	2000	2025
Africa	8.0	14.7	25.2	37.9	51.8
Asia	9.5	17.4	24.7	36.7	50.6
Europe	37.9	52.4	67.3	74.8	81.3
Latin America	25.0	41.4	61.2	75.3	82.2
North America	53.8	63.9	73.8	77.2	83.3
Oceania	48.5	61.6	71.8	70.2	73.3
World	20.5	29.7	37.9	47.0	58.0
More developed countries	40.1	54.9	70.0	76.0	82.3
Less developed countries	9.3	17.8	26.8	39.9	53.3

Source: Lattes, Rodríguez, and Villa 2002.

TABLE 5.6

Urban population percentages living in cities of differing scales, 1950 and 1990

	South America		Mesoamerica	
Size of cities	1950	1990	1950	1990
More than 1 million	12.7	32.5	7.3	22.5
500,000 to 1 million	3.2	5.1	2.2	6.4
100,000 to 500,000	7.5	12.1	9.1	12
20,000 to 100,000	7.4	12.8	7.2	9.9
Less than 20,000	69.2	37.4	74.2	49.2
Number of cities of more than 20,000	194	931	77	279

Source: Pinto da Cunha 2002.

levels and the larger South American countries the smallest levels.

In terms of a simple average across countries included in table 5.7, urban primacy levels have not noticeably changed, although some countries saw significant changes in primacy between 1960 and 2000, as figure 5.1 demonstrates. Of the 21 Latin American countries included in the data for figure 5.1, 12 experienced declines in primacy levels. Costa Rica and República Bolivariana de Venezuela had the largest declines of over 40 percent in their primacy levels. The most notable primacy increases have been in the small countries of Guatemala, Guyana, and Haiti, and in one relatively large country, Colombia. Primacy measures are generally higher in Latin America than in other parts of the world; certainly all have much higher levels than that of the United States. Except for Brazil and R.B. de Venezuela (due to a substantial fall in its primacy level), all Latin American countries have higher primacy levels than Canada.

How does urban concentration affect the contribution of agriculture and rural areas to the national economy?

Economic analyses of the evolution of cities and the role of urban economies in economic growth[16] focus primarily on the relationships among urbanization, urban concentration, and non-agricultural activities. The agricultural sector specifically and rural activities more generally are typically not addressed, except insofar as the rural sector plays an initiating role in the urbanization process, especially as a labor source for industrial employment.[17]

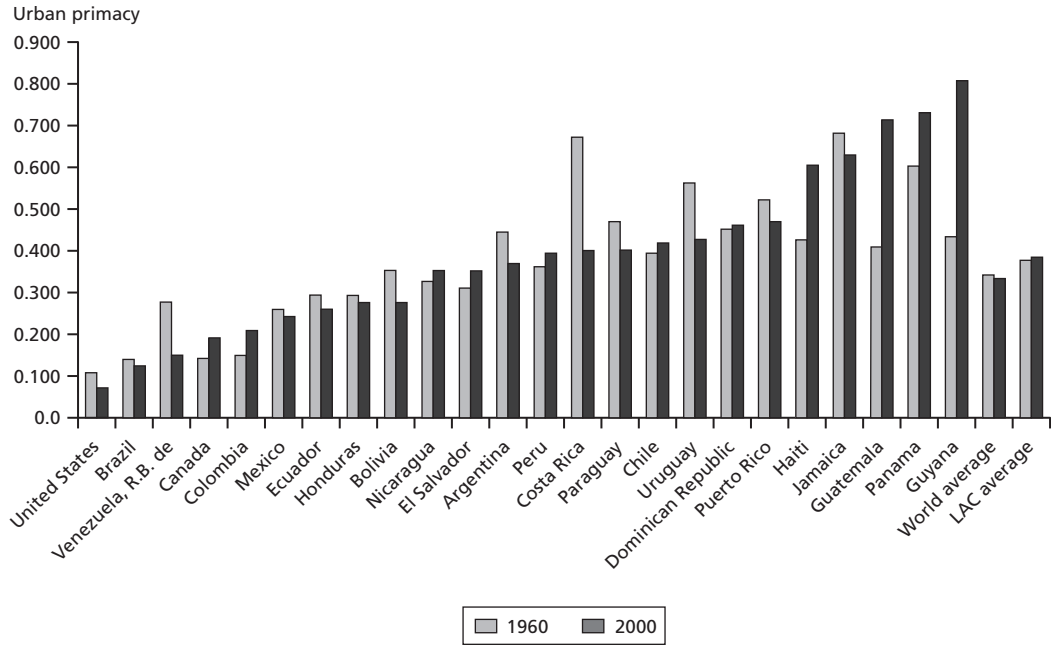
TABLE 5.7

Degree of urbanization and urban primacy in Latin America

	Population (1,000s)	% urban	Urban primacy	
	2000	2000	1960	2000
South America				
Argentina	37,032	89.92	0.45	0.37
Bolivia	8,329	62.47	0.36	0.28
Brazil	170,115	81.28	0.15	0.13
Chile	15,211	85.67	0.39	0.42
Colombia	42,321	73.9	0.16	0.21
Ecuador	12,646	65.33	0.29	0.27
Paraguay	5,496	55.99	0.47	0.41
Peru	25,662	72.77	0.37	0.40
Uruguay	3,337	91.25	0.57	0.43
Venezuela, R.B. de	24,170	86.93	0.28	0.15
Central America				
Costa Rica	4,023	47.85	0.67	0.41
Cuba	11,201	75.31	—	—
Dominican Republic	8,495	65.05	0.46	0.47
El Salvador	6,276	46.64	0.32	0.35
Guatemala	11,385	39.66	0.41	0.72
Haiti	8,222	35.7	0.44	0.61
Honduras	6,485	52.74	0.30	0.28
Jamaica	2,583	56.1	0.68	0.63
Mexico	98,881	74.39	0.27	0.25
Nicaragua	5,074	56.13	0.33	0.35
Panama	2,856	56.23	0.61	0.73
North America				
Canada	30,770	78.70	0.14	0.20
United States	282,224	77.22	0.11	0.08
Latin America average urban primacy			0.40	0.39
World average urban primacy			0.35	0.33

Source: U.N. 2001.
Note: — Not available.

FIGURE 5.1
Urban primacy levels in the Americas, 1960–2000



Source: Foster (2004), based on U.N. data.

Urbanization is considered simply a natural consequence of development: labor is released to urban areas as a result both of shifts in labor-saving technology taking place at the farm level and of changes in the composition of national output toward nonfood production.

Agricultural production and other rural activities take place in remote areas and while urban-oriented economic studies recognize that these activities might be affected by urbanization and urban concentration, at the center of attention are questions related to explaining the industrialization in cities, the patterns of industrial location among different cities, and the interrelationships between national economic growth and urban system development. Once the national economy's rural component has been given a passing acknowledgment, the conversation usually turns to the various reasons for the forms that urbanization might take: the role of agglomeration economies in industrial organization, the distribution and size of urban centers, the relative importance of localization and urbanization economies for urban firms and their choice of location, and the benefits and costs of (perhaps too much) urban concentration in one or two metropolises for the efficiency of industrial production, quality of life, and overall national growth.[18]

There are costs to what urban economists call "excessive" urban concentration; congestion effects in a mega city may provoke politicians to use public resources and interventions to divert resources from more productive activities (investments and social services) toward the sustaining of the quality of life in the metropolis.[19] Is the agricultural sector harmed more or less than other economic sectors by the costs associated with excessive urban concentration? All sectors bear the social costs associated with supporting an excessive level of concentration in a metropolis through the inefficient allocation of resources, but the urban economics literature tends to stress the costs borne by industries in medium-size and smaller urban areas due to underinvestment in urban infrastructure and social services outside the primary city.

The agricultural economics literature has tended, on the other hand, to stress the consequences of an overall urban policy bias for an imbalance of public and private investment (for example, Lipton 1993 and Timmer 2002), resulting in significant differences between urban and rural areas

in the marginal product of physical and human capital. Eliminating obstacles to realizing returns on investment in rural areas due to policy biases favoring urban investment would allow improved efficiency in resource flows and an increase in factor productivity overall (Schultz 1978). Timmer (2002) specifically addresses the possible policy bias favoring urban human capital development, manifested in part by a reduced supply of educational facilities and average years of schooling in rural areas.

But there could be benefits from urban concentration, for rural communities and agriculture. The most obvious potential source of benefits to agriculture would derive from concentrated urban populations, similar to the reduced marketing and search costs that urban suppliers and buyers enjoy. After all, urban concentration is also the geographic concentration of those who want to eat but tend not to grow their own food. Increases in shipping volumes to centralized distribution points reduce the final cost of delivering food to urban consumers, a benefit that can be shared by farmers and consumers through an increase in the farm gate price and a decrease in the retail store price. Rural-to-urban transport networks are less dispersed, supermarkets and other retailers are larger, advertising costs fall with the increase in size of the local intended audience, and intra-urban distribution systems can take advantage of scale.[20]

Nonfarming rural activities are likely tied to agriculture in some way, although their contributions to national income would not be accounted for in agricultural GDP. Processing of agricultural products, transport of raw and processed goods to urban centers (for final consumption, further processing, or export), and other rural-based activities that add value along the marketing chain from farm to city would also benefit from urban concentration as they share in reduced costs.

Furthermore, industry agglomeration in cities reduces the costs of urban-produced goods and services demanded by rural economic activities. The benefits of the localization economies for firms of standardized products in medium-size and small cities would likely not be the result of concentration per se in the metropolis. But indirectly, by reducing the costs of the intermediate goods and services produced in the metropolis to standardized firms in smaller cities, urban concentration's benefits would be passed through to rural businesses and agriculture, as well as to other sectors. More directly, the largest cities are often R&D centers, the focal point of sophisticated finance and insurance markets, and the entry points of foreign technologies, capital goods, seeds, fertilizers, pesticides, and other inputs; and while imported products might be standardized, the importers' services of finding foreign sources and domestic buyers for a variety of goods are less likely to be, especially in a developing country.

To the degree that the social costs of excessive urban concentration in a metropolis arise from poorer investment in infrastructure farther from the metropolitan center than elsewhere, one might initially guess that agriculture would suffer relatively more from policies leading to excessive concentration than would industries located in medium-size and smaller cities. But other considerations would argue that agricultural GDP, relative to rural nonfarm and small city output, might be less negatively affected by excessive growth in the metropolis: (1) one would observe a slower decline in agricultural GDP share because the sector would become relatively less dependent on purchase inputs; (2) agricultural productivity increases are perhaps more dependent on technological innovations arising in (or passing through) the metropolis than are productivity increases in other rural and small city nonfarm sectors; and (3) the provision of cheap agricultural goods to the primary city would likely be a concern to the same politicians that favor skewing infrastructure investment to sustain the quality of life of an excessively concentrated urban population.

Econometric evidence: Urban primacy appears to harm off-farm more than agricultural activities

A cross-country econometric study[21] prepared for this report addresses the roles that urban concentration and rural density play in influencing national economic growth, agriculture's share of total GDP, and agricultural land productivity. The analysis makes use of data for 83 countries between 1960 and 2000 (in the form of five-year averages) on growth rates, urban primacy, rural population density per kilometer of arable land, and other determinants of national and agriculture sector GDPs. Both urban concentration and rural density should positively influence growth through local information spillovers, which in turn affect local knowledge accumulation and agglomeration economies. Excessive urban concentration, however, would draw resources from productive investment and innovation toward nongrowth-promoting investments and innovations associated with attempts to maintain quality of life and economic rents in congested urban centers.

The results confirm previous work (Henderson 2002) showing that urban concentration has a nonlinear effect on national growth rates—positive at low levels of concentration and negative at high levels—and that the effects of concentration are influenced by country scale. The results also show that observed urban primacy rates are generally excessive in terms of economic growth rates. Moreover, the results support the hypothesis that the positive effects of agglomeration economies in rural areas on national economic growth are enhanced with greater rural density.[22] With respect to agriculture's contribution to national income, an increase in rural density has a statistically significant negative effect on the change in agriculture's GDP share relative to total GDP, becoming less negative with increases in urban primacy and more negative with increases in schooling. Increases in urban primacy, on the other hand, have statistically significant positive impacts on agriculture's GDP share.

Evidently, the economies induced by greater rural density contribute to overall growth by stimulating non-agricultural activities more than agriculture. Such nonfarm activities are likely to be both in rural areas and in medium-size and small cities that are physically closer to rural areas. But, more important, the results show that while the diseconomies induced by excessive urban concentration slow overall growth over the range of primacy levels exhibited by most countries (using 2000 reference data), including those of Latin America, they must be doing so by harming non-agricultural sectors more than agriculture. The magnitude of this effect rises with rural population density; probably because less dense rural areas are associated both with fewer non-agricultural rural activities and perhaps because with less rural density there is less economic activity in general that takes place in remote urban areas as well. With respect to changes in agricultural land productivity, the analysis shows that the scale economies associated with rural density and urban concentration positively influence productivity.

Taking together the results for per capita GDP, agriculture's GDP share and land productivity, the agglomeration economies associated with urban concentration apparently decrease nonfarm sector activities more than farming. They do so both by harming non-agricultural activities and by increasing agricultural productivity. The implication is that, although further urban concentration might be excessive from a national growth perspective, the growth in nonfarm rural activities would likely be stunted to a greater degree than the growth in production agriculture. To the extent that rural nonfarm activities are becoming a major source of employment and poverty reduction,[23] the consequences of excessive urban primacy and the diversion of resources to heavily concentrated urban areas are even more costly to society.

5.5 Sources of RNR productivity growth in Latin American and Caribbean countries

How fast can RNR productivity grow in Latin American and Caribbean countries? Answering this question requires knowing, first, how fast the productivity of RNR activities has grown in Latin American and Caribbean countries compared with that observed in some of the most dynamic RNR economies in the world. Second, we need to identify the main factors that have driven RNR sector productivity in various Latin American and Caribbean economies. These two issues are addressed in the following subsections.

RNR productivity growth has been rapid in several Latin American and Caribbean countries

Understanding the drivers of RNR productivity is challenging for a variety of reasons. An important one is that RNR sector products are quite diverse, ranging from fisheries to all sorts of agricultural products. Furthermore, it is quite likely that the same product can be produced with a variety of technologies, allowing radically different economies to produce products that are indistinguishable from each other from the viewpoint of consumers. In other words, maize varieties can be produced in both the United States and Mexico, but farmers in each country probably use dramatically different machinery and crop management techniques.

For these and other reasons, the resurgent academic literature on RNR production functions has been recently dominated by so-called "multi-output" production functions applied to international data and to farm-level data. This approach focuses on the factors that explain the value of RNR production, rather than providing product-specific comparisons. The underlying reason for this approach is that both the output mix and the choice of technologies and management strategies can be simultaneously determined by the quantity of labor, tractors, animals, and so forth, that are used in the production process.

This is the logic of the so-called "translog" production-function approach described in box 5.1. This is a flexible empirical approach for measuring the rate at which the value of any mix of RNR goods is produced for a given level of use of tractors, workers, animals, land, and so forth, which allows the possibility that the productivity of specific factors of production can also rise and the utilization of one

BOX 5.1

Empirical translog production functions

Following Kawagoe, Hayami, and Ruttan (1985) and Lau and Yotoupoulos (1989) our initial assumption is that developed and developing countries exhibit different production functions. In particular, Lau and Yotoupoulos (1989) show that estimating a meta-production function based on international data requires paying close attention to differences in the quality of the inputs. To consider international heterogeneity in the quality of inputs, first assume that input j of a developed country in terms of the input in a developing country r can be expressed as $X_j^* = A_{jr} \cdot X_j$, where a A_{jr} is a conversion factor. Then the translog function is expressed as follows:

$$(1)\quad \ln(Y) = \alpha_0' + \sum_i \alpha_i' \ln(A_{ir} X_i) + \frac{1}{2}\sum_i \sum_j \beta_{ij} \cdot \ln(A_{ir} X_i) \cdot \ln(A_{jr} X_j),$$

which is equivalent to:

$$(2)\quad \ln(Y) = \alpha_0' + \sum_i \alpha_i' \ln(A_{ir}) + \sum_i \alpha_i' \ln(X_i) + \frac{1}{2}\sum_i \sum_j \beta_{ij} \cdot \left[\left(\ln(A_{ir}) + \ln(X_i)\right) \cdot \left(\ln(A_{jr}) + \ln(X_j)\right)\right];$$

the previous expression can be simplified to:

$$(3)\quad \ln(Y) = \alpha_0 + \sum_i \alpha_i \ln(X_i) + \frac{1}{2}\sum_i \sum_j \beta_{ij} \cdot \ln(X_i) \cdot \ln(X_j),$$

where $\alpha_0 = \alpha_0' + \sum_i \alpha_i \ln(A_{ir}) + \sum_i \sum_j \beta_{ij} ln(A_{ir}) \cdot \ln(A_{jr})$, and $\alpha_i = \alpha_i' + \sum_k \ln(A_{kr})(\beta_{ij} + \beta_{ji})$.

Note that in a country in the reference group, all A_{ir} are 1, therefore equation (3) reduces to the regular translog. To capture the factor-augmentation parameters for all countries not included in the reference group, the econometric model needs to include a variable defined as the interaction between a group-identifying dummy variable and the corresponding variable for each factor of production.

This report provides estimates of two regression models, one using as a reference group the developing countries and another using the developed countries. In this manner we avoid the dubious interpretation of the coefficients expressed without tilde, which indeed would allow us to recover elasticities and returns to scale with respect to a reference group. By changing the reference group we can recover true elasticities for each group and true returns to scale.

In addition, we are interested in capturing the evolution of technical progress, ideally in a differentiated manner for each country. Following Kim (1992) we add a time trend and its quadratic term to model (3), so that we can capture the average rate of total-factor productivity (TFPy) growth, which is the portion of output growth that is not explained by the utilized stock of factors of production. Finally, we add the interaction of the time trend variable and the natural logarithm of each factor. This allows us to recover different rates of technical progress associated with changes in the returns to each factor of production. Therefore our empirical production function is specified as follows:

$$(4)\quad \ln(Y) = a_0 + \sum_i a_i \ln\left(X_i\right) + \frac{1}{2}\sum_i \sum_i B_{ij} \cdot \ln\left(X_i\right) \cdot \ln\left(X_j\right) \cdot + \sum_i \gamma_{iT} T \cdot \ln\left(X_i\right) + \delta_T T + \frac{1}{2}\delta_{TT} T^2 .$$

Source: Bravo-Ortega and Lederman 2004a.

factor can affect the productivity of another. In other words, we are interested in measuring how the value of production of RNR products changed over time for a given level of use of the relevant factors of production. In research that Bravo-Ortega and Lederman (2004a) undertook, this approach was implemented with data from the FAO and the World Bank. Table 5.8 presents the resulting RNR productivity growth estimates.

In Latin America and the Caribbean, Brazil is the country with the highest TFPy growth, which averaged 1.93

TABLE 5.8

Total factor productivity growth in RNR activities in Latin America and the Caribbean (LAC) and around the globe

	Average TFP growth (%)	TFP growth over 40 years (%)		Average TFP growth (%)	TFP growth over 40 years (%)
Argentina	1.84	107.61	United Kingdom	1.67	93.64
Bolivia	1,18	60.13	United States	2.11	130.77
Brazil	1.93	114.44			
Chile	1.20	61.32	*High-income average*	1.36	75.51
Colombia	1.43	76.65			
Cuba	1.17	59.10	China	1.67	94.10
Ecuador	1.28	66.23	Hungary	1.14	57.15
El Salvador	0.53	23.31	India	1.98	119.17
Guatemala	0.79	36.83	Indonesia	1.45	77.90
Haiti	0.97	46.95	Iraq	1.13	56.46
Honduras	0.78	36.38	Kenya	0.78	36.23
Mexico	1.85	108.54	Malaysia	1.21	61.58
Nicaragua	0.79	36.98	Mali	0.63	28.54
Paraguay	0.74	34.34	Mauritania	0.40	17.38
Peru	1.36	71.81	Morocco	1.22	62.49
Venezuela, R.B. de	1.35	70.97	Mozambique	–0.04	–1.40
			Myanmar	0.90	43.24
LAC average	1.20	63.22	Nepal	0.69	31.90
			Niger	0.37	16.09
Australia	2.12	131.84	Philippines	1.44	77.09
Austria	0.69	31.79	Romania	1.42	75.42
Canada	1.23	62.95	Rwanda	–0.01	–0.27
Finland	0.25	10.50	Saudi Arabia	0.61	27.79
France	1.77	101.76	Somalia	0.68	30.93
Germany	1.39	73.37	Sri Lanka	0.95	46.07
Greece	1.62	89.85	Sudan	0.96	46.40
Ireland	0.72	33.50	Thailand	1.39	73.58
Italy	1.73	98.59	Tunisia	1.21	61.60
Japan	1.40	74.31	Turkey	1.56	85.73
Netherlands	1.16	58.55	Uganda	0.62	28.19
Portugal	1.41	75.02	Vietnam	1.09	54.52
Spain	1.89	111.50			
			Other countries average	0.74	37.62

Source: Bravo-Ortega and Lederman 2004a.
Note: Average and cumulative growth rate of RNR TFP derived from empirical translog production function.

percent per year during 1960–2000. Mexico follows Brazil with an average increase of 1.85 percent. In the third position and very close to Mexico's average is Argentina, with a 1.84 percent increase. On the last spot of our sample is El Salvador, with an average increase of 0.53 percent. The next-to-last spot is occupied by Paraguay, with an average increase of 0.74 percent per year.

Regarding the high-income countries, the highest TFPy growth was in Australia with 2.17 percent per year, followed by the United States with an average TFPy increase of 2.04 percent. France occupies the third spot with a TFPy increase of 1.74 percent per year. Finland holds the last spot with a very low 0.21 percent. Among the non-Latin American and Caribbean developing countries, India led the group with an average TFPy increase of 1.98 percent, followed by China (1.67 percent) and Indonesia (1.45 percent). Among the lowest TFPy growth in the full sample is Mozambique, with a reduction of 0.04 percent per year.

Average TFPy growth for high-income countries is 1.36 percent per year, followed by Latin America and the Caribbean with an average increase of 1.2 percent. The rest of the poor countries show an average of 0.74 percent. It is clear that several Latin American and Caribbean countries, including Argentina, Brazil, and Mexico, were, in fact, able to achieve relatively high rates of RNR productivity growth during the period under study, namely 1960–2000. These results are consistent with recent studies that have also found quite rapid agricultural productivity growth in

developing countries (Ninn et al. 2003) and with existing evidence on the relatively fast growth of agricultural TFPy in developed countries (Martin and Mitra 2001). The finding that high-income countries have experienced high productivity growth rates cannot be used to support their protectionist policies, because these and other agricultural productivity estimates come from historical data (from 1960–2000 in our case; from 1967–92 in the case of Martin and Mitra), while the protectionism of agricultural activities strengthened substantially in the United States and Europe after the mid-1980s. In fact, it is possible that competitive pressure emanating from imported agricultural products might have been an important driver of agricultural efficiency in the high-income countries. However, from a policy viewpoint, it is perhaps more important to understand the types of factors that are limiting further RNR productivity growth, especially in recent times.

RNR productivity in Latin America and Caribbean countries is limited by inadequate public goods

To study the TFPy determinants across countries, it is easier to estimate what economists call a "Cobb-Douglas production function" instead of the more flexible translog function discussed above. The main reason is that the analysis needs to control for the contribution of factors of production (tractors, animals, land, and labor) as well as factors that influence the context in which RNR production is taking place. For example, infrastructure coverage or the depth of domestic financial markets might affect not only the stock of the factors of production that are available within each economy, but they might also influence the efficiency with which these factors are used. Alternatively, one can think of these country characteristics as the determinants of how much capital, labor, land, and human capital are used for the production of RNR goods and that mix is automatically or endogenously determined by the same factors. For these reasons, the resurgent scientific literature on RNR production efficiency has been dominated by multi-output production functions applied to international as well as farm-level data (see Mundlak 2001).

This section follows this alternative Cobb-Douglas approach. Moreover, due to the slimmed-down Cobb-Douglas production approach, Bravo-Ortega and Lederman (2004a) were able to deal with the difficult econometric issue of the endogeneity (or reverse causality) going from RNR production to the decisions that farmers make to buy additional tractors or hire additional workers. At the country level, this approach is similar to now common approaches used for understanding why some countries develop faster economically than others, such as the cross-country regression approach pioneered by Barro (1991). It is similar in that the fundamental sources of economic growth are thought to be determined by each country's structural and policy characteristics.

The following paragraphs discuss evidence concerning the RNR productivity growth drivers in Latin American and Caribbean countries and in the rest of the world. It is noteworthy that the factors analyzed herein are measured at the country level and thus do not reflect the incidence of rural public goods per se, but rather the overall national coverage of the relevant factors. For example, to study the impact of credit availability or roads, we use the national ratio of credit to the private sector over total GDP and the national total of paved roads per kilometer, rather than agricultural credit or rural roads. This is consistent with the theory discussed above that treats a country's output mix as endogenous to national characteristics. Nevertheless, the direction of the empirical effects of the studied variables could be interpreted as indications of whether the national provision of public goods has favored RNR or agricultural productivity or whether the provision of public goods has suffered from an "urban" bias.

Table 5.9 reports estimated effects on RNR TFPy growth for the Latin American and Caribbean region as a

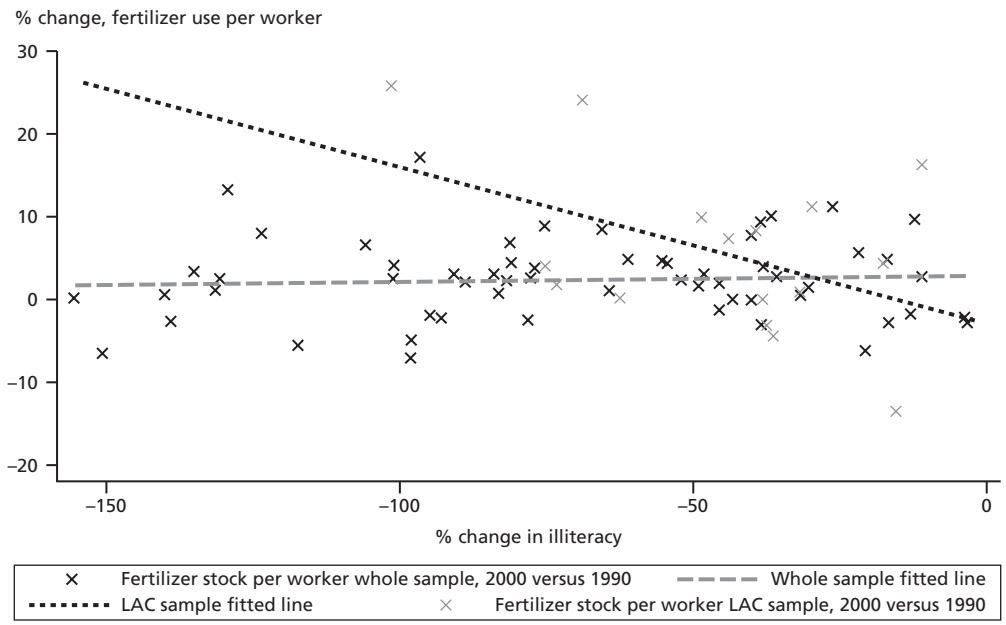
TABLE 5.9

The effect of public goods on RNR-sector productivity growth in Latin America and the Caribbean (LAC) and the rest of the world

	Effect in LAC in the 1990s	Effect in the rest of the world during 1960–1999
Illiteracy	–0.024	–0.019
	0.000	*0.000*
Irrigation	0.120	0.034
	0.180	*0.560*
Roads	0.424	–0.209
	0.000	*0.000*
Telephone density	0.063	0.062
	0.140	*0.020*
Credit to private sector	0.001	–0.001
	0.150	*0.020*
Electricity generation	0.027	0.076
	0.380	*0.000*

Source: Bravo-Ortega and Lederman (2005) provided preliminary econometric estimates.
Note: Effect of a 1 percent increase of each variable on the average annual growth of RNR total factor productivity; p-values of elasticities are listed under each estimate.

FIGURE 5.2
Illiteracy and fertilizer use per worker



Source: Bravo-Ortega and Lederman, based on data from FAO.
Note: LAC = Latin America and the Caribbean

whole during the 1990s. For comparison, this table also provides consistent estimates for the rest of the world during the 1960–2000 period. Both sets of estimates were derived from an empirical Cobb-Douglas RNR production function for the whole world, but with region-specific estimates for Latin America and the Caribbean, which ignored the influence of fertilizer use.

Illiteracy rates, or the portion of the national population that cannot read and write, were a significant determinant of RNR productivity growth, both in Latin American and Caribbean during the 1990s and in the rest of the world. It is noteworthy that a 1 percent illiteracy decline improves Latin American and Caribbean RNR productivity growth by approximately 0.02 percent, slightly higher than in the rest of the world. Also of interest for Latin American and Caribbean policy discussions is the finding that expanding the coverage of paved roads (that is, squared kilometers per capita) in Latin America and the Caribbean was also associated with improvements in the competitiveness of RNR activities, a fact that is not found in the rest of the world nor in other periods of time. Nonetheless, more recent estimations that Bravo-Ortega and Lederman (2004a) reported indicate that the illiteracy effect vanishes when fertilizer use is considered in the analysis. This is due to the empirical finding that Latin American and Caribbean illiteracy improvements during the 1990s were associated with the intensification of RNR production through increased use of fertilizers—as shown in figure 5.2. While the other public goods listed in table 5.9, namely irrigated hectares per worker, telephone density (that is, phone lines per capita), the ratio of private sector credit to national GDP, and electricity generation (in kilowatts) per capita, were not statistically significant contributors to Latin American and Caribbean RNR productivity growth, they all have the expected positive effects. And in some instances, such as electricity generation and telephone density, these variables were important for other countries and time periods. Thus, the provision of public goods seems to be important for the competitiveness of RNR activities and thus for Latin America and Caribbean public policy formulation.

However, it is possible that various Latin American and Caribbean countries face different constraints to their RNR productivity growth. Table 5.10 studies this potential

TABLE 5.10

The effect of public goods on RNR-sector productivity growth in Latin America and Caribbean (LAC) countries during the 1990s (effect of a 1 percent increase in each variable on the average annual growth of RNR TFP for each country)

	Illiteracy	Electricity	Paved roads	Telephone density	Credit	Irrigation
LAC effect[a]	–0.0248	. .	0.4244	. .	. .	. .
Argentina	. .	. .	. .	0.482	. .	. .
Bolivia	. .	. .	. .	. .	. .	. .
Brazil[b]	. .	. .	–0.801	0.701	. .	–0.947
Chile[b]	–0.813	–0.985	–0.888	–0.195	–0.021	–1.189
Colombia	. .	2.160	–1.333	. .	. .	. .
Ecuador	–0.513	–0.962	–0.587	–1.130	. .	–1.817
El Salvador	. .	. .	1.115	1.163	–0.466	3.067
Honduras	–0.171	0.196	–1.483	–0.652	0.040	–2.547
Mexico	. .	. .	. .	. .	. .	. .
Nicaragua	–0.178	. .	. .	. .	0.001	. .
Paraguay	. .	. .	. .	. .	. .	. .
Peru	. .	. .	. .	. .	. .	–10.934
Venezuela, R.B. de	0.109	. .	. .	1.340	0.011	. .

Source: Estimations by Bravo-Ortega and Lederman (2005).
Note: Reported coefficients are significantly different from 0 at 10 percent; . . = Not significant.
a. These regional effects and their p-values are reported in Table 5.9.
b. For computational reasons these countries' deviations cannot be estimated with time dummies; therefore, for Brazil and Chile the reported results were derived from regressions that did not include time dummies.

heterogeneity across Latin American and Caribbean countries; the results presented therein do suggest that the needs of various Latin American and Caribbean countries are different. Again, readers should keep in mind that negative effects of the various public goods on RNR productivity need to be interpreted with caution, since they may reflect that the provision of these public goods has favored urban areas rather than rural areas, where RNR activities are largely concentrated, or they could reflect an overprovision of the relevant infrastructure items in rural areas. Either way, the evidence is only suggestive, but it does indicate that the public policy agenda should be tailored for each country's context. At least the observed heterogeneity should motivate further empirical investigation about the constraints that RNR and agricultural competitiveness face in these countries.

Another weakness of the ongoing analysis must also be recognized. Important and perhaps crucial determinants of RNR productivity in Latin America and the Caribbean countries and elsewhere are the quality and quantity of agricultural R&D expenditures and extension services to aid farmer's adoption of improved production and management techniques. The issues related to these variables are discussed in a special section of chapter 6. Overall, however, it is safe to conclude for now that the RNR competitiveness agenda is probably unique for each country and that these estimates provide some guidance as to which factors need to be examined in each Latin American and Caribbean country. In addition, it is also possible that different regions in Latin America and the Caribbean countries where RNR activities take place also have different needs for stimulating fast-paced productivity growth. The following section examines the determinants of farm-level productivity growth in Ecuador, Nicaragua, and Mexico.

Farm productivity in Ecuador, Nicaragua, and Mexico[24]

As in the previous analyses of the determinants of RNR productivity growth across countries, this section also uses a framework where farm productivity depends on the use of factors of production as well as certain "state" variables that capture the characteristics of farmers and of the regions where they reside. Box 5.2, below, provides a technical discussion of this empirical modeling approach. The following subsections discuss the evidence concerning agricultural productivity drivers in Ecuador, Nicaragua, and Mexico.

BOX 5.2

Empirical farm-level production functions

In a first form of the empirical production functions estimated for Ecuadoran farms and for rural households in Nicaragua, differences in observed productivity levels, as conditioned by the state variables (that is, regional characteristics), are expected to center symmetrically around an average level. More specifically, in this symmetric-error version of the model, total factor productivity differences are explained by differences in state variables (which proxy the technology choice), plus a residual, v, which has an expected value of zero, so that:

$$(1) \quad \ln P(x,s) = \ln y - \sum_j b_j \ln x_j - b_0 = \sum_i a_i \ln s_i + v \ ,$$

where ν is an *iid* error term that is symmetrically distributed.

A second model extends the notion implicit in the endogenous applied technology framework that some states will result, via technology choice, in higher total factor productivity levels than others. Without loss of generality it is therefore possible to rank the predicted productivity measures. Labeling the output outcome associated with the technology that produces the highest productivity level as P_o^*, an inefficiency, measure, $u_n^* = P_o^* - P_n^*$, can be calculated for each observation (n = 1, 2, 3, . . . N). If the technology that produces P_o^* is binding, then the expected value of the inefficiency term will be nonnegative. Since, conversely, the inefficiency term can take on large values, the distribution of the inefficiency term may be truncated and skewed. If this characterization of the inefficiency term is correct, it can be exploited to improve the empirical model, even though the true values of P_o^*, P_n^*, and u_n^* are not observed. In particular, the model can be rewritten so that the error term is a composite of the unobserved inefficiency term and an unobserved random element. Specifically, the model can be rewritten as:

$$(2) \quad \ln P^f(x,s) = \ln y - \sum_j b_j \ln x_j - b_0 - \sum_i s_i = \varepsilon = v - u \ ,$$

where the error term, $\varepsilon = \nu - u$, is composed of the symmetric error term, ν, and a nonnegative random term, u. This composite-error model is a generalization of the original model, since, when $E(u) = 0$, the error term simplifies and the model given in (2) reduces to the model given in (1).

As a practical matter, in the case of the composite-error model, it is necessary to give a specific functional form to the unobserved inefficiency term, u, to separate it from the also-unobserved random component, ν. As a start, we assume that u follows a half-normal distribution, while ν is distributed normally, that is, we assume that the $\nu_i \sim iid\ N(0, \sigma_\nu^2)$ and $u_i \sim iid\ N^+(0, \sigma_\nu^2)$, where the u_i and the ν_i are assumed to be distributed independently of each other and of the regressors. Aigner, Lovell, and Schmidt (1977) and Battese and Corra (1977) first used this specification in their early papers.

Source: Larson, León, and Mugai 2004.

Ecuador

For Ecuador, the bulk of the data used in the analysis is from the 2000 Third Agricultural Census. This census, based on observations from nearly 108,000 farms in Ecuador, contains information about physical output, land use, labor and production methods, as well as key information related to marketing. Farm household information is also collected. Output prices are not part of the survey, although detailed spatial data on farm products are available from ongoing producer price surveys by the national statistical institute (INEC). The authors of the study commissioned for this report (Larson, León, and Mugai 2004) explain how these data were matched with the physical output data. The census data are also supplemented with environmental and climate data taken from the Social and Environmental Monitoring System of Ecuador (*Sistema de Monitoreo Socioambiental Ecuatoriano;* Ecociencia 2002). These data are then used to estimate farm-level production functions, where some of the state variables, such as climate and geography, are at the canton level. Most other variables that explain the farm output value concern the use of factors of production, such as land, labor, capital, fertilizers, and so on, as well as farm size and characteristics of the farmers and of their communities.

TABLE 5.11

Production elasticities in Ecuadoran farms

Production variables	Random-error model				Composite-error model			
	All farms (1)	Small farms (2)	Medium farms (3)	Large farms (4)	All farms (5)	Small farms (6)	Medium farms (7)	Large farms (8)
Labor	0.272	0.064	0.214	0.388	0.307	0.08	0.24	0.43
	(0.006)***	(0.012)***	(0.011)***	(0.009)***	(0.006)***	(0.011)***	(0.010)***	(0.008)***
Irrigated land	0.082	0.154	0.051	0.058	0.081	0.149	0.047	0.062
	(0.001)***	(0.003)***	(0.002)***	(0.002)***	(0.001)***	(0.003)***	(0.002)***	(0.002)***
Share of irrigated land with inputs	0.441	0.378	0.517	0.498	0.41	0.389	0.456	0.445
	(0.006)***	(0.012)***	(0.016)***	(0.011)***	(0.006)***	(0.011)***	(0.015)***	(0.010)***
Rainfed land	0.059	0.143	0.01	0.06	0.052	0.132	0.001	0.055
	(0.002)***	(0.004)***	(0.003)***	(0.003)***	(0.002)***	(0.004)***	–0.003	(0.003)***
Share of rainfed land with inputs	0.43	0.301	0.534	0.421	0.409	0.337	0.5	0.399
	(0.006)***	(0.012)***	(0.013)***	(0.008)***	(0.005)***	(0.011)***	(0.013)***	(0.007)***
Capital	0.069	0.067	0.071	0.06	0.072	0.073	0.076	0.061
	(0.001)***	(0.004)***	(0.003)***	(0.002)***	(0.001)***	(0.003)***	(0.003)***	(0.002)***
Sum of elasticities								
Irrigated with inputs	0.864	0.663	0.853	1.004	0.87	0.691	0.819	0.998
Rainfed with inputs	0.83	0.575	0.829	0.929	0.84	0.622	0.817	0.945

Source: Larson, León, and Mugai 2004.
Note: Numbers in parentheses are standard errors; *** = significance at the 1 percent level.

Larson, León, and Mugai report two sets of results. One concerns the economic returns in terms of additional farm output produced by increases in the various factors of production (land, tractors, capital, and workers). These are called "production elasticities." These factors are important because they tell us whether farms experience diminishing, constant, or increasing returns to scale. In other words, they tell us how much farm output increases if farmers increase, for example, their use of land, perhaps due to land reforms that enlarge the farm plots of small farmers. If the returns to scale are below one, then this means that farmers experience diminishing returns to scale so that increasing land and all the complementary factors of production will result in a less-than-proportional increase in farm income.

As discussed, the set of chosen technologies need not yield identical production functions for all farms. And this appears to be the case in Ecuador as the production elasticities change with scale, as demonstrated by the regression results from Larson, León, and Mugai, which are reproduced in table 5.11. This is most apparent in elasticity sums, given at the bottom of the table, which indicate greater variation across scale than between estimation techniques. For large farms, the elasticity sums are close to one for both irrigated and rainfed farms, indicating nearly constant returns to scale. The sums are lowest for small rainfed farms and increase with scale and with irrigation. Interestingly, the ranges of elasticity sums found in Nicaragua are quite similar to those found in cross-country studies.[25]

The largest source of variation across scale comes from the labor elasticities, which, in the case of the composite-error model, range from 0.08 for small farms to 0.43 for large farms. As indicated, this result is probably influenced by labor-intensity differences, since some small-farm household labor may reflect a lack of alternatives. Nevertheless, cross-country studies indicate that productivity-enhancing technologies generally conserve labor (Larson and Mundlak 1997).

Land elasticities also fall in the range of those found in cross-country studies, but they follow a different pattern across scale. Elasticities are highest for irrigated land on small farms, where land is likely constrained. Medium-size and large farms exhibit similar elasticities for irrigated land. For rainfed land, the elasticity for medium-scale farms is very low and statistically indistinguishable from zero. Differences between the rainfed and irrigated elasticities are small, perhaps due to abundant rainfall in Ecuador. The returns from using additional inputs are high and in line with cross-country studies. Moreover, input use benefits are relatively constant across scale and land type.

For informing public policy, it is perhaps more interesting to assess the impact of the state variables on farm output, since the public sector is probably most able to affect some state variables directly, whereas policies affect factor use only indirectly. Table 5.12 presents the corresponding statistical results.

Overall, the results are consistent with the previously discussed idea that farmer and regional characteristics determine production technologies. Regardless of estimation technique, most of the estimated elasticities are statistically significant; there are notable quantitative differences among the elasticities. In addition, while some elasticities are similar regardless of farming scale, others show significant variation with farm size. These combinations of variation among the state elasticities and across scale have important policy implications. The variations indicate that some mechanisms for policies are likely to be more effective at promoting productivity gains than others. The results also indicate that some variables are particularly important for small-scale farmers who are generally poorer.

Looking first at the effects of farmer characteristics, general education has a positive but quantitatively small effect on productivity, regardless of scale. Education directly related to agriculture has a larger effect than a more general education. This is consistent with the international evidence presented above, where illiteracy was an important determinant of Latin American and Caribbean RNR productivity, since reading and writing are likely to be more relevant for farming than higher-level general academic knowledge. The largest effect is associated with the farm operator's gender. This effect, which can be as large as 20 percent of output on small farms, is likely associated with households headed by a single woman and captures additional constraints on family resources. Moreover, the likelihood that a farm will be managed by a woman changes dramatically with scale; women manage 27 percent of small farms, compared with just fewer than 10 percent of large farms.

The results indicate that markets are an important farm productivity determinant. More productive farmers have access to private technical assistance markets and credit markets and participate in output markets (rather than produce for consumption only). Private credit, rare across all farm sizes, was also important for all scales of farming.[26] However, Larson, Lean, and Mugai report in the appendix to their study that the positive effect of access to private credit disappears for large farms when they control for the potential reverse causality, whereby credit is offered to more productive farmers, thus weakening the conclusion that access to credit is an important constraint to stimulating farm productivity in this country. This is consistent with the international evidence presented above, which showed that the depth of credit markets in Ecuador has no noticeable impact on this country's RNR TFPy. Having access to private technical assistance and an intermediate buyer was especially important for small-scale farmers. Most farmers in Ecuador use intermediate buyers, but the few medium- and large-scale farmers that marketed output directly were more productive. Small farms that are physically more distant from output markets did not measure as significantly less productive than other small farms. However, more remote medium- and large-scale farms registered as slightly more productive. This may reflect that remote farms must be more productive to compensate for higher marketing costs, although this may also be an artifact of the way that output value is calculated. For example, if output prices are not adequately adjusted downward for additional transport costs, then the elasticity will, in part, capture this.

Looking at public services, the largest effects are associated with government provision of credit and technical assistance to small farms. Again, these estimates assume that the public sector's decision to offer these services to farmers is not affected by each farmer's productivity. This implies that we need to interpret the results with caution, since if this assumption is far from reality, then the positive effects of these variables could be misleading. In any case, the technical assistance elasticity is smaller than that associated with private technical assistance and the opposite is true with credit. Still, very few farmers benefit from these services in Ecuador—less than 2 percent of small farmers receive public technical assistance and less than 1 percent receive public credit. In contrast, land-titling averages are high—nearly 70 percent for small farmers and nearly 80 percent overall. Nevertheless, only in the case of medium farms did land titling show up as a significant farm productivity determinant.

The social capital measures are statistically significant and exert some influence on productivity. Assistance from the *gremio* (or trade association) is important for all types of farms. Lower productivity levels are associated with speaking an indigenous language at home for small- and medium-scale farmers. However, higher productivity is associated with native indigenous language skills for large farmers, perhaps because of a better ability to communicate with a wider hired labor pool.

TABLE 5.12

Effect of state variables on Ecuadoran farm production (effect of a 1 percent increase in each variable on farm output, percent)

	Random-error model				Composite-error model			
	All farms	Small farms	Medium farms	Large farms	All farms	Small farms	Medium farms	Large farms
Farmer characteristics								
Formal education	0.013	0.01	0.012	0.016	0.014	0.01	0.013	0.018
	(0.001)***	(0.002)***	(0.002)***	(0.002)***	(0.001)***	(0.002)***	(0.002)***	(0.002)***
Agricultural training	0.05	0.061	0.071	0.036	0.061	0.087	0.093	0.042
	(0.003)***	(0.007)***	(0.006)***	(0.003)***	(0.003)***	(0.007)***	(0.006)***	(0.003)***
Female head of house[a]	–0.167	–0.205	–0.146	–0.153	–0.159	–0.209	–0.134	–0.129
	(0.012)***	(0.017)***	(0.021)***	(0.024)***	(0.011)***	(0.016)***	(0.020)***	(0.023)***
Markets								
Technical assistance[a]	0.198	0.302	0.104	0.127	0.206	0.357	0.133	0.111
	(0.019)***	(0.041)***	(0.036)***	(0.028)***	(0.019)***	(0.038)***	(0.035)***	(0.027)***
Credit [a]	0.293	0.402	0.314	0.146	0.325	0.38	0.308	0.219
	(0.021)***	(0.041)***	(0.035)***	(0.032)***	(0.020)***	(0.038)***	(0.034)***	(0.031)***
Intermediate buyer*	–0.064	0.212	–0.04	–0.251	–0.082	0.218	–0.061	–0.271
	(0.013)***	(0.022)***	(0.022)*	(0.021)***	(0.012)***	(0.020)***	(0.022)***	(0.020)***
Output markets[a]	0.85	0.635	0.808	0.84	0.852	0.646	0.796	0.805
	(0.019)***	(0.027)***	(0.035)***	(0.043)***	(0.018)***	(0.025)***	(0.034)***	(0.041)***
Markets remote[a]	0.092	–0.02	0.014	0.155	0.114	0.039	0.046	0.163
	(0.012)***	(0.029)	(0.021)	(0.016)***	(0.011)***	(0.027)	(0.020)**	(0.016)***
Public services								
Share of land titled	0.016	–0.006	0.043	0.021	0.023	0.018	0.055	0.026
	(0.011)	(0.018)	(0.018)**	(0.018)	(0.010)**	(0.017)	(0.018)***	(0.017)
Public technical assistance[a]	0.085	0.194	0.114	0.021	0.077	0.224	0.092	0.008
	(0.027)***	(0.060)***	(0.048)**	–0.037	(0.025)***	(0.056)***	(0.046)**	–0.036
Public credit [a]	0.113	0.598	0.003	0.106	0.091	0.587	–0.003	0.09
	(0.031)***	(0.114)***	(0.066)	(0.037)***	(0.029)***	(0.107)***	(0.064)	(0.035)**
Social capital								
Gremio assistance	0.186	0.121	0.225	0.153	0.196	0.124	0.211	0.175
	(0.014)***	(0.034)***	(0.025)***	(0.020)***	(0.014)***	(0.031)***	(0.024)***	(0.020)***
Indigenous language[a]	–0.04	–0.106	–0.174	0.143	–0.073	–0.194	–0.217	0.135
	(0.013)***	(0.022)***	(0.024)***	(0.023)***	(0.013)***	(0.020)***	(0.023)***	(0.022)***
Risk								
Rain variability	–0.588	–0.934	–0.563	–0.172	–0.45	–0.766	–0.435	–0.037
	(0.037)***	(0.065)***	(0.061)***	(0.063)***	(0.035)***	(0.060)***	(0.058)***	–0.06
Land diversification	–1.436	–0.981	–1.399	–1.74	–1.333	–0.828	–1.35	–1.642
	(0.015)***	(0.027)***	(0.027)***	(0.024)***	(0.014)***	(0.026)***	(0.026)***	(0.023)***
Geography								
Moist climate[a]	0.114	0.213	0.166	–0.045	0.08	0.139	0.117	–0.049
	(0.016)***	(0.026)***	(0.025)***	–0.028	(0.015)***	(0.024)***	(0.024)***	(0.027)*
Humid climate[a]	0.03	–0.009	0.115	0.002	–0.021	–0.112	0.048	–0.008
	(0.016)*	(0.027)	(0.026)***	(0.028)	(0.015)	(0.025)***	(0.026)*	(0.027)
Wet climate[a]	0.111	0.154	0.274	–0.073	0.126	0.138	0.243	–0.018
	(0.016)***	(0.032)***	(0.028)***	(0.027)***	(0.016)***	(0.029)***	(0.027)***	(0.026)
Slope of land	–0.444	–0.523	–0.266	–0.392	–0.401	–0.48	–0.265	–0.339
	(0.027)***	(0.047)***	(0.048)***	(0.043)***	(0.026)***	(0.043)***	(0.047)***	(0.042)***
Scale								
Medium[a]	0.823				0.79			
	(0.013)***				(0.012)***			
Large[a]	1.553				1.552			
	(0.015)***				(0.015)***			

Source: Larson, León, and Mugai 2004.
Note: Numbers in parentheses are standard errors; ***, **, and * denote statistical significance at the 1, 5, and 10 percent level, respectively.
[a] indicates discrete variables.

Expectations regarding the relative risk of alternative technologies are expected to influence farmers' production choices.[27] In the context of our model, farmers are likely to forego otherwise attractive and available technologies in favor of technologies that, ex ante, mitigate risks (Rosenzweig and Binswanger 1993).[28] The results suggest that foregone output associated with diversifying land uses was significant for all farms, but costs increased with the farm scale. This, in part, reflects the higher opportunity costs of higher-revenue cropland for large farms. In contrast, the historical rainfall variation had a greater negative impact on small farmers, which may be attributed to a constrained ability to invest in risk-mitigating on-farm investments.

As discussed, the Ecuadoran climate is divided into four separate classes, based on a combination of rainfall, soil quality, and evaporation rates. For estimation purposes, the driest of the climates is suppressed and the elasticities can be viewed as a discrete change associated with a climate change. The results suggest that climate endowments influence farm productivity—primarily for small- and medium-scale farms. The topological measure, related to potential soil erosion, is quantitatively more important for all farms and especially small farms. Finally, these results can explain why farm productivity varies across regions in Ecuador. By definition, this issue is related to the spatial or territorial rural development approach, discussed in chapters 5 and 6 of this report.

Nicaragua

Donald Larson (World Bank) conducted a similar analysis for Nicaragua, but it was based on data from 1998 household surveys. The methodologies used are comparable to those used for Ecuador. The survey data for Nicaragua do not provide information on all the variables studied in the case of Ecuador, but they provide more information on agricultural workers, allowing us to study the effects, for example, of family versus hired labor. The analysis focuses on 520 households with complete data with 50 *manzanas* or less of land, for which it is safe to assume that production technologies are similar across households. Nevertheless, much can be learned about the potential roles that the public sector can play to improve the competitiveness of Nicaraguan agriculture. Table 5.13 presents the statistical evidence, which reports the results derived from a variety of econometric techniques, thus allowing us to be more confident about the robustness of the evidence.

The sum of the estimated effects of the factors of production (labor and capital) are low compared with other studies and to those from Ecuadoran farms. This finding implies that Nicaraguan farming families face decreasing returns to scale, thus suggesting that adding factors of production (land, labor, and capital) has larger positive effects on smaller farming operations. Regarding labor, hired labor is about 12 percent more productive than family labor, which suggests that commercial farming tends to be more productive than family or subsistence farming. Durable capital items (buildings and land improvements) are significant family farm income determinants, but the corresponding elasticities are economically small. Equipment capital (tractors and so on) have about same quantiative estimate, but standard errors are larger, thus rendering them irrelevant. Similarly, the effects of technical assistance, diversification (using land for noncrops—mostly livestock), and social capital (participation in farmers organizations) are not statistically significant. Interestingly, farmers' identification of drought problems did not show as significant either. Finally, as in the case of Ecuador, total factor productivity was higher among farmers that participated in output markets. The sources of regional differences in small farm productivity in Nicaragua are also discussed in chapter 4.

Mexico

The Mexican data also come from a recent rural household survey. Barceinas, Juárez, and Yúnez-Naude (2004) conducted the statistical analysis; Jose Mariá Caballero of the World Bank supervised their work. The researchers conducted similar analyses to those that Don Larson and his colleagues did for Ecuador and Nicaragua. The corresponding analysis covered 666 rural households surveyed in 2003. The study of the Mexican case was conducted in a slightly different manner than those on Ecuador and Nicaragua. Barceinas and his colleagues estimated an efficiency frontier and then explored the relative inefficiency determinants in a second stage. An interesting finding from the first part of the analysis was that maize and beans production in Mexico is significantly less productive than other farming activities, probably due to the fact that these crops are highly protected in Mexico (see OECD 2003). Table 5.14 reports the results from the second step.

As expected, but in contrast to Nicaragua, households that experienced climatic problems appear to be less efficient than other households. Farmers who did not have access to credit actually seem to be more productive than other households. The authors provide two explanations for

TABLE 5.13

Determinants of household agricultural output in Nicaragua, 1998

	Base model	Heteroskedastic model	Exponential distribution	OLS	Simulation model
Land	0.076	0.082	0.081	0.074	0.048
	(0.028)***	(0.029)***	(0.029)***	(0.028)***	(0.016)***
Labor	0.053	0.05	0.054	0.052	0.053
	(0.015)***	(0.015)***	(0.015)***	(0.016)***	(0.015)***
Portion of labor hired	1.123	1.094	1.13	1.1	1.117
	(0.208)***	(0.211)***	(0.205)***	(0.212)***	(0.208)***
Capital (buildings and land improvements)	0.018	0.018	0.018	0.016	0.018
	(0.007)***	(0.007)***	(0.007)***	(0.007)***	(0.007)***
Capital (equipment)	0.01	0.011	0.011	0.01	0.011
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Diversification	0.321	0.345	0.387	0.204	
	(0.273)	(0.276)	(0.275)	(0.265)	
Technical assistance[a]	–0.159	–0.165	–0.162	–0.138	
	(0.126)	(0.128)	(0.125)	(0.136)	
Does not participate in markets[a]	–1.131	–1.123	–1.138	–1.051	–1.151
	(0.130)***	(0.130)***	(0.126)***	(0.135)***	(0.129)***
Social capital[a]	0.147	0.138	0.127	0.132	0.104
	(0.183)	(0.185)	(0.182)	(0.194)	(0.176)
Drought	–0.084	–0.062	–0.07	–0.147	–0.097
	(0.129)	(0.131)	(0.126)	(0.136)	(0.129)
Constant	8.456	8.483	8.105	7.445	8.479
	(0.189)***	(0.192)***	(0.178)***	(0.178)***	(0.187)***
σ_u^2	1.333***	1.364***	0.733***		1.323***
	(0.116)	(0.116)	(0.080)		(0.119)
Region 2 dummy		–0.626			
		(0.830)			
Region 3 dummy		–0.529			
		(0.786)			
Region 4 dummy		–0.786			
		(0.859)			

Source: Estimates by Donald F. Larson based on household survey data.
Note: Numbers in parentheses are standard errors; ***, **, and * denote statistical significance at the 1, 5, and 10 percent level, respectively. OLS = ordinary least squares.
[a] indicates discrete variables.

this counterintuitive result: first, it is possible that credit is not used to make productive investments, but rather for alternative consumption or for off-farm production; and second, it is possible that credit has positive long-term effects, but this cannot be captured in the analyses presented here because they are based on single-year data. However, the evidence from Ecuador, as well as the RNR productivity analysis for the whole Latin American and Caribbean region that was, in fact, estimated with data from 40 years, was also ambiguous with respect to credit's role in promoting agricultural productivity.

As in Ecuador and Nicaragua, the variable that captures assistance from farming organizations has a positive effect on inefficiency, suggesting that rural households in Mexico that seek such assistance are less productive than the rest. In addition, public assistance program (PROCAMPO and Oportunidades) or community assistance beneficiaries do not seem to suffer from abnormal inefficiency levels. Family labor, the type of land used for agricultural production (communal or *ejidal* versus the others), and the status of being a large-scale producer are all irrelevant for productive efficiency of Mexican rural households. Overall, the evidence for Mexico suggests that most of the differences in agricultural incomes in the country are driven by the product mix (maize and beans having lower returns), factor use (not reported here), and regional characteristics.

TABLE 5.14

Determinants of household agricultural inefficiency in Mexico, 2003

Explanatory variables	Coefficients
Products (difference with respect to maize and beans)	
Other grains	0.03
Coffee	–0.37*
Horticulture	–0.22*
Perennial crops	–0.15*
Climatic problems	0.18*
Services and programs	
Outside sources of finance (share of agricultural production)	0.00*
Share of services offered by community (out of 9 types)	0.17
Farmer organizations (1 = present in community)	0.07*
Share of household members of working age	–0.01
Government program (1 = beneficiary of PROCAMPO or Oportunidades)	0.01
Land and scale	
Mixed land use (1 = private and communal land)	–0.01
Private land (= 1)	–0.01
Large scale (1 = more than 5 hectares planted)	–0.03
Head of household characteristics	
Gender (1 = female)	0.06
Language (speaks language besides Spanish)	0.00
Education in years	0.00
Age	0.00
Regions (difference with respect to Central Region)	
South-Southeast	–0.11*
Central-West	–0.27*
Northwest	–0.33*
Northeast	–0.33*

Source: Barceinas, Juárez, and Yúnez-Naude 2004, table IX.
Note: Effects of each variable on agricultural production inefficiency: Positive coefficients imply less efficiency. Number of households = 666;.
* significant at 10 percent.

Policy implications

The experience of farms and households in Ecuador, Mexico, and Nicaragua provides some additional ingredients for a fruitful policy debate about the public sector's role. First, as the international evidence shows, access to credit might not be fundamental for improving agricultural competitiveness in Latin American and Caribbean countries, especially among small-scale farmers. The evidence for Ecuador did show a positive correlation between public credit access and farm productivity, but, as mentioned, this result could be spurious, depending on how the public sector allocates such credit. Moreover, the share of farms that reported public credit access in Ecuador is so small that the resulting estimate could be driven by a handful of strange observations. Second, regional characteristics might be quite important, and thus the material discussed in chapter 4 on the spatial approach might be important for understanding agricultural productivity in these countries. Third, government assistance has, at best, no direct impact on agricultural competitiveness, with the very important exception of R&D services in Ecuador. This topic is discussed in detail in chapter 6 of this report. Nonetheless, the fact that credit does not seem to be an important factor in shaping agricultural or RNR efficiency does not mean that financial market issues are irrelevant for rural and RNR sector development. These issues might be crucial for mitigating the perverse effects of economic uncertainty, as mentioned in chapter 3. Policy issues related to the public sector's role in fomenting credit availability in rural areas are discussed in chapter 7.

Notes

1. Claudio Bravo-Ortega (University of Chile) and Daniel Lederman (World Bank) wrote this section.

2. The algebra is simple, but the intermediate step between (2) and (3) is not obvious. It entails dividing both sides of the equality maximization condition by W and twice multiplying both sides by ratios equal to one, so that: $(1/W)(R/R)(\delta W/\delta R)(\delta R/\delta G_R)(G_R/G_R) = (1/W)(U/U)(\delta W/\delta U)(\delta U/\delta G_U)(G_U/G_U)$.

3. This is not even the case for equally priced consumption bundles defining the poverty lines.

4. The arithmetic to prove this point is trivial. The benefit incidence approach implies that the optimal distribution of expenditures is given by: GR/Rural Poor = GU/Urban poor. This means that GR/GU = Rural Poor/Urban Poor.

5. See Schiff and Valdés 2002.

6. Though not pure public goods, education and health care have characteristics of public goods. Their positive externalities are well documented in the literature. Moreover, the poor are generally unable to finance even highly profitable investments in human capital, so if governments do not intervene in some form, such investments are often not realized.

7. In fact, if government expenditures have little efficacy as a consequence of their highly unbalanced structure toward subsidies, this debate is quite misguided. More rural public spending may simply mean greater support to certain groups in the rural sector, but not necessarily greater support to agriculture and other rural industries.

8. See, for example, Bregman and others (1999) for Israel, Fakin (1995) for Poland, Lee (1996) for Korea, Bergstrom (1998) for Sweden, Estache and Gasper (1995) for Brazil, and Harris (1991) for Ireland.

9. For a formal analysis of the consequences of underinvestment in public goods for long-run economic growth, see López et al. (2001).

10. Public support to human capital formation for the poor can either be in the form of the direct government provision of education and health care services or in the form of vouchers and other transfers that allow access to privately provided services.

11. The FAO's Regional Office in Santiago collected the data.

12. López uses both random effects and fixed effects estimation, finding very similar results for both approaches.

13. See, for example, Lipton (1993) and Timmer (2002).

14. It is noteworthy that the sectoral shares approach is identical to the benefit incidence approach when poverty is the target in the national welfare function. If the policy maker is concerned only about reaching the poor, then allocating public expenditures so that each poor family, whether rural or urban, receives the same amount of benefits is the same as allocating expenditures according to the share of poor families found in each sector.

15. Useful overviews of the state of urbanization, spatial distribution, and migration in Latin America can be found in Pinto da Cunha and Cerrutti and Bertoncello.

16. Henderson (2003) reviews this literature in the Handbook of Economic Growth.

17. Traditionally, the economic development literature has taken the entire rural sector to be agriculture, which plays five development roles: to increase food supply for domestic consumption; to release labor for industrial employment; to enlarge the market for industrial output; to increase the domestic savings supply; and to earn foreign exchange. See Johnston and Mellor (1961) and Timmer (2002).

18. The volume edited by Tolley, Gardner, and Graves (1979) contains essays that analyze private and social costs and benefits from increasing city size. As an example of concentration diverting investments from more productive activities, Henderson (June 2002) cites the high per capita costs of infrastructure and housing investments of locating a family in a mega-city. Richardson (1987) reports that per capita investment costs of incorporating a family in a mega-city are three times that of locating the family in a small city. Henderson (2002) addresses the question of the effect of urban concentration in a primate city on the quality of life in other urban areas. The possible adverse effects on rural quality of life have not been studied to the same extent.

19. Henderson (2002) finds that if, ceteris paribus, a primate city is the national capital, its size is expected to increase by more than 25 percent. Both Henderson (1988) and Ades and Glaesser (1995) conclude that state decentralization (a federal system) is associated with lower urban concentration levels. Henderson (2002) connects decentralization's positive benefits associated with more efficient city-size distributions in developing countries to the availability to autonomous local governments of locally controlled revenue sources. Davis and Henderson find that governments can influence the degree of urbanization only indirectly, by favoring some economic sectors over others (for example, via agricultural protection or import substitution policies). But governments can influence more directly urban primacy (concentration) through infrastructure investments (or lack thereof in other areas) and the democratization and fiscal decentralization levels.

20. Moreover, to the degree that a city develops its own "personality" and buyer and consumer habits are more likely to center around a single pattern, the activities involved in processing, packaging, quality control, and marketing can focus to a greater degree on a large market of roughly similar expectations of a product's size, shape, and quality, rather than on many smaller urban markets with a variety of idiosyncratic demands. And in a large city, the diversity of culinary tastes very likely stimulates experimentation and innovations in food products, affecting at least the demand for processors' services, if not altering the demand pattern for farm products by opening up niche markets for goods that might have otherwise not been produced in favor of planting staples.

21. Foster 2004.

22. Also examined was the influence of urban concentration and rural density on schooling's contribution to per capita income growth. Schooling effects are enhanced when the national urban population is more concentrated in the primary city and diminished when the rural population is denser. These results are likely due to the greater returns generated by human capital in the type of economic activities more often found in large metropolitan areas and the lower returns to human capital in the type of economic activities that are associated with and encouraged by higher population concentrations in rural areas. The results for national growth and for agriculture's GDP share are entirely consistent with household studies on returns to education, which implies a ranking of returns: higher for urban activities, less high for nonfarm rural activities, and lowest for farming activities.

23. See the recent article on economic reforms in India between 1970 and 2000 by A.D. Foster and M.R. Rosenzweig. They conclude that nonfarm growth plays an important role in the increase in rural incomes and that nonfarm growth is especially pro-poor.

24. This section borrows heavily from studies that Donald Larson (World Bank) and coauthors wrote. See the references in the text.

25. See Mundlak, Larson, and Butzer (1999) and Mundlak's (2001) review.

26. Just under 4 percent of small farms, 5 percent of medium farms, and fewer than 6 percent of large farms received credit.

27. See recent reviews by Moschini and Hennessy (2001) and Anderson, Larson, and Varangis (2004).

28. Risks also result in ex ante losses that are not measured here.

CHAPTER 6

Policy and the Competitiveness of Agriculture: Trade, Research & Development, and Land Markets

THIS CHAPTER TURNS TO THREE POLICY AREAS THAT ARE OF PRESENT AND FUTURE importance to the RNR sector generally and to agriculture in particular: trade, research and development (R&D), and land policy. International trade in RNR products is notably important in many Latin American countries, as in other developing countries, because of its level of trade integration with the rest of the world. Exports have traditionally been and will continue to be a factor in the sector's and the national economy's growth, which has implications for income generation and poverty alleviation, especially in rural areas. As a consequence, both external and internal conditions are important determinants for the consequences of expanding trade and further liberalization of trade policies.

But while the international agricultural trade environment sets the context for the sector's contribution to national growth, an individual country's sector-specific trade policies are not a panacea for bettering the economic performance of rural areas. Certainly, market failures affecting the provision of goods and services in the rural economy do not justify trade protection, and national and international trade reform is only one element of the region's broader development agenda.

Other policies—such as those related to overcoming market and government failures in R&D provision, efficient land allocation in terms of ownership and rentals, rural credit and insurance, infrastructure development, and the promotion of other activities in areas unlikely to benefit from RNR sector growth—are complementary to (and for *all* rural activities perhaps of longer-term significance than) the liberalization of the world trade regime for enhancing the rural economy's growth. A country's ability to take advantage of the opportunities connected to changes in the international rules of the game for RNR trade will depend on domestic policies that address specific deficiencies in the way markets function in relation to the rural economy.

The first part of this chapter addresses what is known about the impacts of international agricultural trade liberalization for Latin American and Caribbean countries. It also discusses individual country levels of agricultural trade protection. The second part reviews the important sector-specific question of agricultural R&D for fostering productivity. The third part presents a discussion of public policies related to agricultural land, especially land administration and the role of property rights, possible inefficiencies in farmland use, and access to land as a potential poverty reduction strategy. Chapter 7 covers other domestic policies related to all rural economic activities and rural household welfare more generally. Chapter 8 discusses policies related to households and regions that are unlikely to benefit from agriculture sector growth, especially in light of its integration in world markets.

6.1 The international trade regime, country trade policies, and the RNR sector

External conditions and trade liberalization's effects on commodity prices and trade

At present, broadly speaking, international terms of trade are favorable for the RNR sector. But there is no reason to believe that commodity price cycles have disappeared; in the future greater openness to trade in RNR products will have consequences for exposure to international price risks, for both the rural and the national economy.

Beyond world commodity market trends, there have been recent policy developments that present special opportunities and challenges to the region's RNR sector. The most directly important (although perhaps not the most long-term significant) development has been the several bilateral and subregional trade agreements. Following the earlier North American Free Trade Agreement (NAFTA), MERCOSUR, the Andean Group, and the Central American and Caribbean agreements, the most notable new initiatives have been with U.S. participation: agreements with Chile, Central American Free Trade Agreement (CAFTA) (including the Dominican Republic), negotiations with the Andean Group, and FTAA negotiations. There have also been agreements between Chile and Mexico, Canada, the European Union (EU), and Korea; other negotiations are in progress, such as between Mexico and Japan and between MERCOSUR and the EU. These concluded and future agreements will increase pressures on the competitiveness and induce adjustment of national RNR sectors.

Beyond the region, the most important trade policy development concerns the possible farm policy changes in the EU and United States, and the related current WTO negotiations under the Doha Round. Although there has been modest agricultural policy reform progress in OECD countries, as observed by support levels, there has been some movement toward greater market orientation. There has been a shift away from market price supports and output payments towards programs that provide income supports relatively more "decoupled" from production decisions. The overall level of OECD farmer support has not significantly decreased following the Uruguay Round, but there has been a change in the mix of the types of policies used. As assessed by S. Tangermann (2003), the distortions between domestic producer prices and international market prices have lessened, as market price supports and output payments have decreased notably as a share of total support.

Importantly, the EU, the United States, and other major world markets players have recently stated their willingness to discuss an eventual removal of export subsidies and a reduction in domestic subsidies. Although the policy debate is still fluid and has yet to yield final results, one can anticipate a reduction in protection of agriculture in OECD countries, which will have consequences for increasing international prices to some degree. What are the likely impacts on Latin America of these future international trade policy developments?

A number of recent studies have analyzed the impact of multilateral trade liberalization on global and regional welfare. Global, multiregional, and multisector computable general equilibrium (CGE) studies apply a variety of models such as GTAP, the World Bank's LINKAGE, and MIRAGE, and apply differing specifications and policy simulations. There are also studies that use partial equilibrium frameworks, such as those by Hoeckman and others (2002), Rosegrant and Meijer (2002), and Vanzetti and Sharma (2002). The FAO has applied its ATPSM model, and OECD (2002a) has used AGLINK. What can one conclude from these modeling efforts? In particular, what are the sources of welfare gains of trade policy changes and who are the main beneficiaries?

The first observation that can be made regarding these studies is that all models predict that trade liberalization leads to an expansion of trade flows, higher commodity prices, and welfare gains for the liberalizers. With varying degrees of success, the models attempt to incorporate both the tariff reductions and the removal or expansion of import quotas in OECD countries. With respect to welfare gains to individual developing countries, most can be attributed to their own trade reforms. For example, the World Bank reports[1] that for developing countries, 83 percent of total welfare gains from global agricultural trade reform derive from their own trade liberalizations. There are, of course, differences in the details. The general equilibrium models, where economic sectors are interlinked, produce larger global welfare gains than those implying a partial equilibrium approach. Although one should not place too much confidence in dynamic, general equilibrium simulations of long-run outcomes, dynamic CGE models predict even greater welfare gains by incorporating endogenous productivity growth and capital accumulation related to trade openness. For many studies, the results appear to indicate that with respect to the relative significance of market access and domestic support in

industrial countries, developing countries are the winners from global tariff reductions, but the losers from domestic support elimination.

Regarding the distribution of gains among industrial and developing countries, the results vary greatly. The static version of the World Bank's LINKAGE model predicts that low- and middle-income countries would capture half of the total gains from full liberalization. Other studies (Cline 2003; Dimaranan, Hertel, and Martin 2002) estimate that these shares are closer to one-third. The partial equilibrium models also differ: Rosegrant and Meijer estimate that over one-half of total welfare gains are absorbed by developing countries, while Vanzetti calculates that only one-quarter go to developing countries. Moreover, the studies disagree as to the principal sources of welfare gains due to trade liberalization. The World Bank's LINKAGE simulations suggest that most of the welfare gains in developing countries stem from their own liberalization. This is reinforced by Vanzetti's results showing that developing countries gain only from unilateral trade liberalization, but lose from liberalization in industrial countries. In Dimaranan et al., considering all economic sectors, only one-quarter of the welfare increase in low-middle-income countries are due to their own liberalization.

One source of welfare losses for developing countries is that, especially for chronic net food importers, consumers suffer higher food costs with global agricultural policy reform, because many of the subsidies in richer countries are presently stimulating the production of food staples, such as wheat, and thus reducing world prices of these products. Moreover, the wide differences in estimates for the gains to a developing country as a whole are due in part to how individual developing countries are treated in the models. In particular, there are some developing countries that now enjoy trade preferences that allow them to sell at the EU and U.S. internal prices, which would fall from tariff reduction. They would gain from world price increases, but lose from falling domestic prices in their preferred trading partners. The large difference between the studies' results, with respect to which countries are winners and losers, also emphasizes that the simulations are sensitive to model specification and parameter choices. Differences in baseline scenarios and the baseline year, sectoral coverage, and regional decomposition are crucial, as are trade elasticities, which determine the substitution between domestic and the foreign goods.

World price distortions: How much? The implications for domestic price determination

An argument is commonly made in political debates in Latin America that world prices are false guides for determining domestic price of imported goods, because they are so distorted by high OECD agriculture subsidies. This is less an argument about efficiency (and certainly not about consumer welfare) than it is about "fair trade" and treatment for domestic producers. Does research on trade liberalization's effects support this contention of highly distorted world commodity prices? The predicted directions of effects on world prices are fairly uniform across studies, with most price increases occurring for commodities that are heavily protected in the baseline periods. Such commodities include wheat, sugar, rice, processed meat, and dairy products (see table 6.1), of which sugar and dairy product markets are the most distorted. In addition, several studies find that markets for processed foods are subject to significant tariff escalation, implying that processed foods sector reforms could yield significant gains to developing countries beyond the benefits that might arise from reform in primary agriculture alone.

The magnitude of the price increases differ across products and across studies, but are on the order of 10 percent, although in some particular cases they are higher. For example, with the exception of the dynamic general equilibrium simulations of Fontagne, and van der Mensbrugghe and Beghin, the modeling efforts predict that prices for sugar (one of the most protected commodities) would increase between 0 and 10 percent. The dynamic general equilibrium (GE) models predict 20 to 40 percent increases and as high as 71 percent. For wheat, again with the exception of one model, price increases run 12 percent or less. In general, global liberalization gives higher world price increases than partial liberalization, but the overall conclusion from these simulation studies is that in both industrial and developing countries, trade liberalization would produce commodity price increases that would be small relative to what is generally perceived as compensation for world price distortions in the debate in Latin America on price supports to import-competing producers.

The political debates typically center on the possibility of highly distorted *levels* of world prices rather than the price transmission of volatile world prices. There are instruments to deal with volatility without introducing higher protection levels. Moreover, relevant to the question of how much lower are world prices relative to what they

TABLE 6.1

Summary of world price results for multilateral trade policy liberalization simulations (percent)

Simulation	Model	Sector	Wheat	Rice/ paddy rice	Sugar/ refined	Bovine meat/ beef	Processed dairy/ milk	Maize	Poultry
Full global liberalization									
Dimaranan and others (2002)	Static, GE	All merchandise	25.2	5.5	5.9	6.7	13.1	—	—
Rosegrant and Meijer (2002)	Static, PE	Agriculture	8.1	13.1	—	18.0	—	9.6	11.9
Vanzetti (2002)	Static, PE	Agriculture	15.9	4.5	—	11.6	—	7.8	11.0
van der Mensbrugghe and Beghin (2004)	Dynamic, GE	All merchandise	5–15	—	20–40	—	20–40	—	—
Industrial country liberalization									
Dimaranan and others (2002)	Static, GE	All merchandise	23.0	5.0	6.7	6.5	11.9	—	—
Rosegrant and Meijer (2002)	Static, PE	Agriculture	0.8	1.6	—	5.2	—	2.9	3.8
Vanzetti (2002)	Static, PE	Agriculture	11.5	1.9	—	7.2	—	3.1	2.6
Beghin and others (2002)	Static, GE	Agriculture	12.0	5.5	9.0	10.4	8.3	—	—
Developing country liberalization									
Dimaranan and others (2002)	Static, GE	All merchandise	1.6	0.5	–0.6	0.2	0.7	—	—
Rosegrant and Meijer (2002)	Static, PE	Agriculture	8.1	11.5	—	12.4	11.6	6.7	8.1
Vanzetti (2002)	Static, PE	Agriculture	4.1	2.1	—	4.1	4.2	4.7	7.9
Partial liberalization									
Dimaranan and others (2002)	Static, GE	All merchandise	12.6	2.3	2.8	2.8	5.8	—	—
Bouet and others (2003)	Static, GE	All merchandise	10.1	14.5	10.0	6.0	31.3	—	—
Fontagné and others (2003)	Dynamic GE	All merchandise	14.0	11.0	71.0	15.0	85.0	—	—
Rosegrant and Meijer (2002)	Static, PE	Agriculture	4.1	6.0	—	8.1	14.0	4.8	5.6
Vanzetti (2002)	Static, PE	Agriculture	7.1	1.7	—	4.5	6.6	2.8	4.1
Thompson et al. (2002)	Static, PE	Agriculture	–0.2	0.5	—	3.6	9.5	0.2	—
Thompson et al. (2002)	Static, PE	Agriculture	1.4	0.2	—	5.5	6.8	1.3	—
Thompson et al. (2002)	Static, GE	Agriculture	4.6	—	—	1.3	1.3	—	—

Source: Krivonos 2004.
Note: — Not available.

would otherwise be with trade liberalization is the unarguable observation that simulated world price changes are small relative to the standard deviation of year-to-year price volatility in primary commodity markets. Rodrik argues that trade liberalization effects are likely to be dwarfed by other sources of price variability, and is supported by Gilbert's (2003) estimates of the yearly standard deviation of price changes for maize (15 percent), rice (23 percent), soybeans (16 percent), sugar (43 percent), and wheat (16 percent). This does not minimize the importance of a permanent increase in 10 to 15 percent in world prices.

Which is more important for agricultural trade—tariffs or subsidies in rich countries?

A recent background study using a gravity model of bilateral trade in agricultural products between the United States and other countries (Bianchi, Rozada, and Sanguinetti 2004) found that the point estimate of the elastic-

ity of U.S. imports with respect to a tariff reduction is six times that of the elasticity with respect to the tariff-equivalent of "subsidies." In the study, "subsidies" represent the wedge between the domestic and world price attributable to nontariff border measures and subsidies. This confirms the findings of other studies (Hoekman, Ng, and Olarreaga 2002) emphasizing the importance of tariffs versus subsidies in determining import demand of agricultural goods. A decline in subsidies would reduce the incentives for U.S. domestic production (the reduction depending on the degree of decoupling of subsidies), but without a change in tariffs, consumers would face the same price. Imports might increase as domestic production fell, but the total quantity bought by consumers would remain constant. A decline in tariffs, however, would increase the total quantity demanded. The empirical evidence does show the importance of the displacement effect on agricultural imports from nontariff supports maintaining domestic producer prices above world prices, but the negative effect of tariffs on import demand is much greater.[2]

This has implications for Latin American and Caribbean countries for both WTO and FTAs with the United States and Europe. In terms of market access, Latin American and Caribbean countries would have greater returns to negotiating tariff reductions and expanding import quotas relative to what certainly would be difficult and lengthy negotiations over total subsidy reduction. The attention of Latin American and Caribbean countries may be misdirected toward the appalling level of expenditures of rich countries on agriculture. The evidence shows that focusing on the reduction of border protections (tariffs and quotas) in rich countries would yield significant gains in trade volume. Of course, for many countries, rich and not so rich, a tariff is a means of maintaining producer income that does not require government payments, yields revenues, and passes protection costs to consumers. Reducing tariffs may be all the more difficult if, in political terms, it would require an increase in government's outlays aimed at farmers in the context of a cap on fiscal expenditures.

The heterogeneity of the effects of trade agreements on welfare in Latin America

Beyond the effect on world prices, much of the discussion of the potential benefits of trade reforms is centered on liberalization's impact on increases in the value of exports. Most global trade liberalization simulations project large increases in exports from Latin America. Similarly, the elimination of all tariffs (including tariff equivalents) in the Western Hemisphere due to the FTAA is estimated to lead to an increase in the exports of Latin American agricultural products by 14 percent.[3] The outcomes of such tariff reductions would differ, of course, by product and country. The Inter-American Development Bank (IDB) estimates that exports would rise by over 10 percent for all subgroups of countries in hemisphere, except Mexico and Canada. Andean group exports rise about 12 percent, those from Argentina and the Central American and Caribbean group by 15 percent, and from Brazil and Chile about 27 percent.

From a body of global liberalization studies one can make three broad generalizations: (1) agricultural prices will increase due to multilateral trade agreements by 10 percent or less, which is relatively small compared to the inherent volatility of world prices; (2) exports will increase significantly; and (3) in absolute dollar terms, the global welfare gains are large and captured primarily by trade liberalizing countries. But the results for welfare gains, while positive in the aggregate, are typically small for individual countries relative to national GDP, especially for large economies.[4]

In addition, in each country, it is more difficult to determine the direction of the impact of more open agricultural trade for low-income, net-food-buying consumers in Latin America in urban and rural areas. In terms of low-income households, as for example, Anderson (2004) tentatively concluded, the presumption is that a more liberal world trade regime would have the effect of directly alleviating poverty in developing countries by boosting unskilled labor demand and exports of poor countries.

Nevertheless, there is a concern that the recent trade liberalization trend in Latin America might have negative effects on unskilled labor demand, which would be translated into lower wages, unemployment, and poverty. The Gasparini, Gutierrez, and Porto (2004) commissioned background study explores the potential link between trade and labor outcomes in rural areas in Latin America by estimating cross household-survey regression models with micro-data from 60 Latin American and Caribbean household surveys and country aggregate data. The study merges data for more than 4 million individuals surveyed in 17 Latin American and Caribbean countries between 1989 and 2002, with measures and indicators of international trade, mostly drawn from the World Bank Statistical Information Management & Analysis (SIMA) database. The sample is representative at the national level, covering more than 85 percent of the region's total population in Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras,

Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, and República Bolivariana de Venezuela. The resulting dataset combines variability of aggregate variables with heterogeneity at the country level. The international trade measures used are exports, imports, and trade as a share of GDP, and prices of exports, imports, and agricultural products; aggregate labor market date includes wages, employment, and labor income.[5]

The study finds a significant association between individual labor outcomes and some trade measures, in particular exports, trade as a share of GDP, and export prices. The study's main result is that international trade has been associated with higher wages and labor income in rural areas. The benefits of trade in terms of labor income do not differ by groups of formal education. Instead, those workers located in the bottom quantiles of the conditional wage distribution appear to benefit more from increased openness to international trade. Higher export prices are also associated with higher wages, employment, and labor income; all individuals in rural areas benefit about the same due to higher export prices. Interestingly, the results for urban areas are rarely statistically significant: trade does not affect total labor income in urban areas as measured either by volumes or prices.[6] The study supports the view that a higher trade exposure may bring about an agricultural sector expansion and benefits to those factors intensively used in rural areas, including labor, consistent with comparative advantages.[7] Under this interpretation, the results are consistent with trade and convergence models, whereby economic activity relocates from large urban centers to smaller cities.

Different trade reform consequences for different countries

Looking across the heterogeneous Latin American and Caribbean region, one would expect variation among countries from global agricultural trade reform impacts, reflecting their international trade status in food and agriculture products. As shown in chapter 2, 17 of 22 countries in the Latin American and Caribbean region are net food importers, 9 of which are net agricultural product importers, as more generally defined. In the short-term, multilateral liberalization will likely harm large groups of people in these 17 countries. This is not to deny that from a longer-term perspective, trade liberalization across all economic sectors would expand growth and ultimately serve to raise incomes and reduce poverty. Several studies have shown that more openness to all trade is correlated with faster national growth, but in the short- and medium-term there will be some losers.

One way of anticipating agricultural trade liberalization's possible net effect is to assess the net trade positions of Latin American and Caribbean countries in relation to the various degrees of protection of farm products in the OECD. Tables 6.2 and 6.3, below, present net trade balances (in dollars and percentages of exports and imports) by individual countries according to subsets of products receiving three distinct protection and support levels (available data 1999–2001[8]) in the OECD, using average exports and imports during the period 2000–02. Protection is typically concentrated in a subset of products (for example, the Common Agricultural Policy [CAP] coverage in the EU), and so the higher the protection and support level (as defined by the nominal protection coefficient [NPC] and the Producer Subsidy Equivalent [PSE]), the lower the number of products covered (and included in calculating the net trade balances in table 6.2).

For example, in the case of Argentina in table 6.2, only $125.5 million of its average annual agricultural exports for 2000–02 are in the subset of agricultural goods that are very highly protected in the OECD (NPCs > 1.85 and PSEs > 50 percent), namely, sugar and rice. These exports represent only slightly more than 1 percent of its total agricultural exports (from table 6.3). On average, Argentina imports annually $3.6 million of these very highly protected products, giving a net trade balance ratio of 34.5 of exports to imports for this subset of agricultural goods.

If the subset is expanded to include dairy and other products at the second support level (NPCs > 1.20, PSEs > 40 percent), Argentina's exports increase to $429 million, but proportionally less than the increase in imports to $27.3 million (X/M = 15.7). By expanding the product subset still further to include those that are at least moderately OECD-protected (NPCs > 1.15, PSEs > 28 percent), Argentina's exports rise dramatically to $4,337.3 million. Its imports increase to $112.1 million, giving it a net export trade balance of 38.7 for products that are at least moderately protected. It is worth noting that Argentina's *total* agricultural exports averaged $10.9 *billion* during 2000–02, which implies that the country's exports are heavily oriented toward products with relatively lower OECD protection levels.

One of the striking results of tables 6.2 and 6.3 that emerges is that by far, most countries (15 of 22) are net importers (that is, X/M < 1) of products that are "at least moderately protected." Moreover, these moderate-to-highly protected products represent a significant share of total imports of agricultural goods, averaging 36 percent

TABLE 6.2

Trade balance of agricultural products for different OECD protection levels, 2000–02 average (current dollars millions)

Product subset	Group 1 Very highly protected NPC ≥ 1.85 PSE ≥ 50%			Groups 1 & 2 At least highly protected NPC ≥ 1.20 PSE ≥ 40%			Groups 1, 2, & 3 At least moderately protected NPC ≥ 1.15 PSE ≥ 28%		
Country	Exports	Imports	Balance X/M	Exports	Imports	Balance X/M	Exports	Imports	Balance X/M
Argentina	125.2	3.6	34.5	429.0	27.3	15.7	4,337.3	112.1	38.7
Bolivia	11.5	3.7	3.2	18.4	17.5	1.1	64.8	131.8	0.5
Brazil	1,863.4	130.3	14.3	1,889.7	409.7	4.6	5,769.5	1,738.5	3.3
Chile	0.3	63.9	0.0	48.2	99.8	0.5	125.0	493.7	0.3
Colombia	207.4	39.2	5.3	256.4	74.2	3.5	269.0	605.6	0.4
Ecuador	24.6	7.2	3.4	25.7	11.6	2.2	49.0	117.9	0.4
Paraguay	7.6	2.2	3.5	7.8	12.4	0.6	329.2	34.6	9.5
Peru	16.5	64.1	0.3	23.0	128.3	0.2	30.3	468.2	0.1
Uruguay	160.9	17.7	9.1	313.1	20.1	15.6	626.6	65.7	9.5
R.B. de Venezuela	13.8	67.7	0.2	15.4	235.1	0.1	59.9	600.2	0.1
Total South America	2,431.2	399.4	6.1	3,026.7	1,036.0	2.9	11,660.4	4,368.2	2.7
Costa Rica	31.6	12.8	2.5	52.4	28.3	1.8	92.9	188.7	0.5
El Salvador	59.3	13.7	4.3	61.5	93.7	0.7	80.7	241.5	0.3
Guatemala	210.9	11.6	18.2	211.6	79.0	2.7	251.3	227.2	1.1
Honduras	15.5	18.7	0.8	19.7	54.4	0.4	22.6	121.9	0.2
Mexico	70.5	114.4	0.6	116.6	843.9	0.1	270.8	4,569.1	0.1
Nicaragua	37.8	14.8	2.6	59.1	30.9	1.9	134.3	65.0	2.1
Panama	16.5	2.8	5.9	27.5	27.4	1.0	39.8	80.7	0.5
Total Central America and Mexico	442.0	188.9	2.3	548.4	1,157.5	0.5	892.4	5,494.0	0.2
Cuba	477.6	121.1	3.9	477.7	219.4	2.2	477.8	432.4	1.1
Dominican Republic	84.0	20.1	4.2	84.0	51.4	1.6	84.1	186.2	0.5
Haiti	—	106.3	—	0.0	135.1	0.0	0.0	175.2	0.0
Jamaica	69.5	42.6	1.6	78.5	83.6	0.9	79.1	159.8	0.5
Trinidad & Tobago	30.2	23.5	1.3	33.8	69.4	0.5	39.0	131.3	0.3
Total Caribbean	661.3	313.5	2.1	674.1	558.9	1.2	680.0	1,084.9	0.6
Total Latin America and the Caribbean	3,534.5	901.8	3.9	4,249.2	2,752.4	1.5	13,232.8	10,947.1	1.2

Source: Authors' calculations based on FAOSTAT and OECD data.
Note: Group 1, very highly protected: products with a producer NPC ≥ 1.85 and PSE ≥ 50 percent; rice and sugar. Group 2, highly protected: products with 1.20 ≤ NPC < 1.85 and 40 percent ≤ PSE < 50 percent; dairy and sheep and goat meat. Group 3, moderately protected: products with 1.15 ≤ NPC < 1.2 and 28 percent ≤ PSE < 40 percent; beef, wheat and nonmaize grains, maize, and oilseeds.

for the region. The notable net-exporters of these products are Argentina, Paraguay, and Uruguay, and to a lesser extent, Brazil, Cuba, Guatemala, and Nicaragua. Due to the importance of sugar for several Central American and Caribbean countries, it is in the category of products with the *highest* protection levels that one finds that most countries are net exporters: 16 of the 22 countries in table 6.2.

Considering both levels and composition of exports, some countries could potentially capture relatively greater returns to the reduction of the highest OECD protection levels (sugar and rice), especially in the Caribbean and in Guatemala.

Looking at the absolute levels and their share in total exports, Argentina, Brazil, Nicaragua, and Paraguay are clear cases where the largest gains would arise in reduction of protection for products that are moderately protected in the OECD. Nevertheless, approximately 60 percent of their agricultural exports face even lower protection levels by OECD

TABLE 6.3

Percent of trade in all agricultural products for different OECD protection levels, 2000–02 average

			Group 1		Groups 1 & 2		Groups 1, 2 & 3	
	Total value		Very highly protected NPC ≥ 1.85 PSE ≥ 50%		At least highly protected NPC ≥ 1.20 PSE ≥ 40%		At least moderately protected NPC ≥ 1.15 PSE ≥ 28%	
Country	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Argentina	10,900.0	872.9	0.01	0.00	0.04	0.03	0.40	0.13
Bolivia	403.3	232.0	0.03	0.02	0.05	0.08	0.16	0.57
Brazil	16,000.0	3,768.2	0.12	0.03	0.12	0.11	0.36	0.46
Chile	3,351.4	1,228.4	0.00	0.05	0.01	0.08	0.04	0.40
Colombia	2,925.6	1,577.5	0.07	0.02	0.09	0.05	0.09	0.38
Ecuador	1,592.1	475.2	0.02	0.02	0.02	0.02	0.03	0.25
Paraguay	519.3	310.1	0.01	0.01	0.02	0.04	0.63	0.11
Peru	739.4	1,052.8	0.02	0.06	0.03	0.12	0.04	0.44
Uruguay	998.0	387.3	0.16	0.05	0.31	0.05	0.63	0.17
R.B. de Venezuela	329.6	1,813.5	0.04	0.04	0.05	0.13	0.18	0.33
Total South America	38,000.0	11,900.0	0.06	0.03	0.08	0.09	0.31	0.37
Costa Rica	1,698.2	518.5	0.02	0.02	0.03	0.05	0.05	0.36
El Salvador	539.3	822.0	0.11	0.02	0.11	0.11	0.15	0.29
Guatemala	1,434.7	793.0	0.15	0.01	0.15	0.10	0.18	0.29
Honduras	630.8	491.1	0.02	0.04	0.03	0.11	0.04	0.25
Mexico	8,191.1	11,200.0	0.01	0.01	0.01	0.08	0.03	0.41
Nicaragua	404.4	294.2	0.09	0.05	0.15	0.11	0.33	0.22
Panama	313.0	417.3	0.05	0.01	0.09	0.07	0.13	0.19
Total Central America and Mexico	13,300.0	14,700.0	0.03	0.01	0.04	0.08	0.07	0.37
Cuba	812.8	848.2	0.59	0.14	0.59	0.26	0.59	0.51
Dominican Republic	595.0	691.9	0.14	0.03	0.14	0.07	0.14	0.27
Haiti	23.2	362.0	—	0.29	0.00	0.37	0.00	0.48
Jamaica	260.2	404.8	0.27	0.11	0.30	0.21	0.30	0.39
Trinidad & Tobago	248.8	344.5	0.12	0.07	0.14	0.20	0.16	0.38
Total Caribbean	2,310.2	3,746.4	0.29	0.08	0.29	0.15	0.29	0.29
Total Latin America and the Caribbean	53,600.0	30,300.0	0.07	0.03	0.08	0.09	0.25	0.36

Source: Authors' calculations based on FAOSTAT and OECD data.
Note: Group 1, very highly protected: products with a producer NPC ≥ 1.85 and PSE ≥ 50 percent; rice and sugar. Group 2, highly protected: products with 1.20 ≤ NPC < 1.85 and 40 percent ≤ PSE < 50 percent; dairy and sheep and goat meat. Group 3, moderately protected: products with 1.15 ≤ NPC < 1.2 and 28 percent ≤ PSE < 40 percent; beef, wheat and nonmaize grains, maize and oilseeds.

countries (that is, either NPC < 1.15 or PSEs < 28 percent). By contrast, for Cuba, the bulk of benefits would come from the most highly protected group of products (namely, sugar), which accounts for nearly 60 percent of its exports of agricultural products.

Some countries that are notable net exporters of agricultural products are also net importers of products that receive moderate to very high OECD protection. For example, Colombia and Chile exported $2.9 and $3.3 billion annually, on average, in all agricultural products for the period 2000–02 (table 6.3). For the subset of products "at least moderately protected" in the OECD, Colombia and Chile were net importers, only exporting $269 and $125 million annually, representing 9 percent and 4 percent, respectively, of their total agriculture-related exports. By contrast, these moderate-to-highly protected products represent approximately 40 percent of both countries' total agriculture-related imports. For these two countries, a

reduction in protection (and a world price increase) of products with lower levels of OECD support would have greater impact in expanding exports than the reduction in supports for moderate to high protection.

One implication of the trade percentages by protection category in table 6.3 is that reducing the highest protection levels would be perceived to be of obvious benefit to a number of countries in the region from the viewpoint of their current agricultural trade patterns: Brazil (12 percent), Cuba (59 percent), Guatemala (15 percent), and Uruguay (16 percent).[9] Considering a wider group of protected products (groups 1–3), the majority of Latin American and Caribbean countries are net importers, with exports oriented to products with lower protection rates. In the long run, without such OECD protection, Latin American and Caribbean countries would increase their exports in some of these moderate-to-highly protected products, and perhaps some countries that are now net importers would become net exporters. But in the near term, tariff and subsidy reductions for products with moderate protection levels (which would lead to higher world prices of those products) would be felt negatively by most (15 of 22) Latin American and Caribbean countries, which are net importers of those goods. A strategic question for a country's trade negotiation position is how to assess the possibilities for trade reversals, which is primarily a private sector task.

From the perspective of present trade balance patterns, most Latin American and Caribbean countries would recognize greater *export-related* benefits from a broad reduction in OECD protection on products with relatively low OECD support that affect the bulk of their agricultural exports. But one should keep in mind that protection as defined here considers *both* tariffs and subsidies in terms of NPCs and PSEs. There are, however, likely some products for which tariffs are relatively high, but other government support is low or zero, such as the case of tariff escalation for semi-processed and processed agricultural goods. Governments typically handle these products outside the scope of agricultural policy, and they are perhaps outside of the focus of "agriculture" trade negotiations. For this reason, simply because a country's exports are oriented to products with relatively low OECD "protection," does not mean that it would not benefit from a reduction in high tariffs, although negotiations over such a reduction would be done in a non-agriculture forum.

In terms of the potential consequences of a more open world trade regime on consumers and especially the poor, the impact will depend not only on the world price effects and the net trade position of a country, but also on a country's own protection levels for its domestic farm sector. Examining in more detail existing protection in Latin American and Caribbean countries will show the scope for lowering import barriers and thus mitigating the consequences of the adverse changes for importers and consumers.

Latin American and Caribbean protection levels: Is there a trade policy bias for or against RNR activities?

In the past, the policies of many developing countries, including a number in the Latin American and Caribbean region, discriminated against their own agriculture. This was typically done by taxing agriculture directly (for example, by controlled food prices and export taxes), but also and more importantly indirectly through industrial protection and macroeconomic policies. These implicit taxes (or indirect effects) on agriculture derived from overvalued exchange rates and policies protecting industrial sectors, which turned domestic terms of trade against the farm sector and raised input prices.[10] In 2004, almost certainly the bias is considerably below what it was when measured for the 1970s and 1980s, although, unfortunately, a serious comparative analysis for the last decade and covering a number of countries has yet to be done to update the estimates of the direct effects (since 1995) and of indirect effects (since 1985).[11] During the 1990s, many of these interventions were indeed eliminated or reduced in scope. According to a World Bank study,[12] tariffs on industrial products have been lowered more than those on agricultural products, and exchange rate overvaluation is less prevalent. Nevertheless, the broad perception remains that many developing countries still retain a policy bias against agriculture. Is this true in Latin America? To address this question, one can turn to what is known regarding the direct effects of tariffs.

What do tariff protection profiles tell us?

One protection measure is found in the tariff schedules that countries report to the WTO. Tables 6.4 and 6.5 present a summary of most favored nation (MFN) tariffs corresponding to the year 2000, and their tariff peaks (tariffs greater than 15 percent).[13] Contrary to the widespread image of an unprotected, competitive, export-oriented agriculture in Latin America, one notes from the tariff schedules that MFN tariffs on agricultural and food product imports are relatively high for many countries. Over the countries presented, the average tariff for livestock is 17 percent, for crops, 12 percent, and for textiles, 18 percent. Mexico has the highest MFN tariffs for agriculture and food products

TABLE 6.4

Average MFN tariff rates by product category, 2000

Categories	I	II	IV	X	XI	XXI.I	XXV	
Countries	Livestock	Crops	Foodstuffs, beverages, and tobacco	Wood pulp, paper	Textile	Machinery, electrical equipment	Miscellaneous manufactured articles	Total lines across categories
Argentina	17.0	10.2	18.5	15.8	21.0	17.2	21.8	1,449
Bolivia	9.4	10.0	10.0	10.0	10.0	8.7	9.9	1,554
Brazil	16.7	10.6	18.5	15.1	20.6	18.6	21.6	1,417
Chile	9.0	9.0	9.0	9.0	9.0	9.0	9.0	1,658
Colombia	19.5	12.7	19.0	14.0	18.6	11.0	17.8	1,586
Guatemala	15.5	10.6	12.9	4.8	18.8	4.0	11.4	1,628
Honduras	15.5	11.4	15.4	5.6	17.1	4.9	12.8	1,574
Mexico	27.1	19.7	23.1	13.2	24.8	16.7	24.1	1,750
Peru	24.5	17.2	21.7	12.0	18.0	12.0	12.0	1,462
Paraguay	15.8	10.4	17.8	15.2	20.9	13.1	19.0	1,536
Uruguay	14.7	9.8	17.8	14.1	20.1	15.3	19.9	1,494
Venezuela, R.B. de	19.5	12.8	19.1	13.9	18.8	11.8	18.3	1,586
Average tariff	17.0	12.0	16.9	11.9	18.1	11.9	16.5	—
Average number of tariff lines	34	66	64	100	519	658	117	658

Source: WTO.
Note: — Not available.

TABLE 6.5

Proportion of tariffs by product category, with tariff values exceeding 15 percent

Categories	I	II	IV	X	XI	XXI.I	XXV	XXI.II
Countries	Livestock	Crops	Foodstuffs, beverages, and tobacco	Wood pulp, paper	Textile	Machinery, electrical equipment	Miscellaneous manufactured articles	Machinery and mechanical appliances
Argentina	0.53	0.00	1.00	0.85	0.97	0.69	1.00	0.16
Bolivia	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Brazil	0.55	0.00	1.00	0.80	0.94	0.86	1.00	0.81
Chile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Colombia	1.00	0.61	0.95	0.74	0.95	0.37	0.92	0.03
Guatemala	0.71	0.47	0.72	0.15	0.77	0.14	0.54	0.00
Honduras	0.75	0.46	0.74	0.15	0.78	0.15	0.55	0.04
Mexico	0.66	0.65	0.75	0.16	0.94	0.69	0.97	0.34
Peru	0.85	0.44	0.78	0.00	0.76	0.00	0.00	0.07
Paraguay	0.61	0.01	0.91	0.81	0.93	0.46	0.85	0.07
Uruguay	0.43	0.00	0.97	0.72	0.91	0.65	0.92	0.14
Venezuela, R.B. de	1.00	0.64	0.94	0.71	0.97	0.45	0.94	0.04

Source: Calculated from WTO data.

(categories I, II, and IV), followed by Peru. Chile has the lowest tariffs, and in 2004, the uniform MFN is even lower at 6 percent. Overall, crops and the wood products sectors are protected comparably less than livestock. Processed food products also receive higher protection, demonstrating the widespread phenomenon in industrial and developing countries of tariff escalation. Of the various sectors, textiles are generally most protected, and industrial protection is similar to livestock and processed foods, but higher than crops.

Tariff averages by broad categories of products reflect the situation of many activities, some very small, and hide the protection to a few sensitive and generally larger subsectors. To understand protection profiles, it is more rele-

vant to examine tariff peaks. A tariff peak is defined as a high tariff value exceeding some threshold. In the context of industrial countries' tariff profiles, the commodities on which most tariff peaks apply are generally those of relatively greater importance for developing countries as exporters[14] that account for a large share of total developing country exports. From a political economy viewpoint, this is where the "action" is, and in post-Cancun WTO discussions the question of tariff peaks is being explicitly addressed. Table 6.5 presents the proportions of tariff lines in Latin American and Caribbean countries by product category, that have tariff values exceeding 15 percent.

Except for Bolivia and Chile, where uniform (and low) tariffs are the rule, one notes that there are surprisingly high proportions of tariff peaks in all product categories, in many cases, more than 70 percent of all category lines. The highest proportion of tariff peaks is found in Argentina, Brazil, Colombia, and República Bolivariana de Venezuela. As in the case of average tariffs by product category, livestock and food products generally have a greater number of peaks as a proportion of tariff lines than do crops. Nevertheless, the proportion of tariff peaks for crops is noticeably high for Colombia, Guatemala, Honduras, Mexico, Peru, and R.B. de Venezuela. Conspicuously, the six MERCOSUR countries (including associated members) have no crop tariff peaks, although for forestry, livestock, and processed food, there is a very high incidence of tariff peaks for this group of countries (excepting Bolivia and Chile). Although MERCOSUR has uniformly low crop protection, in the other half of the countries, crops are protected by tariffs that exceed 15 percent in 45 percent or more of tariff lines in that category.

What emerges from the tariff data is that, contrary to a general bias in trade policies against agriculture, there appears to be a bias in favor of at least livestock and processed foods across most countries. And for crops, the evidence is heterogeneous, depending on the particular country. What is clear is that there is scope for tariff reductions that might counteract the negative effects on consumers of world price increases due to global trade liberalization. Given that there is room for tariff reductions on importables—and in the context of ongoing FTAA and WTO negotiations that will accentuate the pressure to lower trade barriers further—one can anticipate a strong political interest in possible compensation programs to cushion the transition toward a freer trade regime for producers and consumers adversely affected by tariff reductions (especially coming from FTAA) and higher world prices (if the Doha Round succeeds). Chapter 8 addresses possible types of compensation schemes that might provide such a cushion.

6.2 Latin American and Caribbean public provision of agricultural R&D[15]

Recognizing its good public nature, government agricultural R&D funding among Latin American and Caribbean countries expanded rapidly in the 1960s and 1970s, stagnated in the 1980s and early 1990s due to tightening fiscal constraints, and recently enjoyed a slight increase. Over the 1976–96 period, publicly-funded research investments grew more slowly in Latin America and the Caribbean than in any other developing region except for Sub-Saharan Africa (see table 6.6), although privately-funded research has grown. Has this relatively low level of taxpayer support led to missed opportunities?

Although the Latin American and Caribbean region as a whole has higher research intensity measures than other developing country regions (research spending per agricultural GDP, per capita, or per economically-active agricultural population), the region's intensity measures are less than one-third the average of developed countries. Direct government fund supports (that is, block grants) were still the prevalent form of financing the national agricultural research institutions (INIAs) in the early 1990s (averaging 66 percent of total funding for countries for which data are available, see table 6.7). Argentina and Chile were the only two countries with less than 50 percent of funding coming from direct government grants. For the INIA in Argentina, a special tax on several commodities was the major income source, while for the INIA in Chile, research contracts were

TABLE 6.6

Public agricultural research expenditures: Annual growth rates (percent per year)

Years	1976–81	1981–86	1986–91	1991–96
Developing countries	7.0	3.9	3.9	3.6
Latin America and the Caribbean	9.5	0.5	0.5	3.5
Sub-Saharan Africa	1.7	1.4	0.5	–0.2
China	7.8	8.9	2.8	5.5
Asia/Pacific (except China)	8.2	5.1	7.5	4.4
West Asia/ North Africa	7.4	4.0	4.2	3.5

Source: Beintema and Pardey 2001.

TABLE 6.7

Funding sources for Latin American and Caribbean public agricultural research in the 1990s

Country	Year	Government subsidy	Sales produce and services	Earmarked taxes	Donors	Private	Other
Argentina	1991	21	1	67	0	0	12
Brazil	1991	95	4	0	0	0	1
Chile	1994	41	26	0	8	5	21
Colombia	1991	80	14	0	2	4	0
Ecuador	1991	58	21	0	12	0	9
Guatemala	1991	71	3	0	1	0	25
Mexico	1991	88	5	2	4	0	1
Panama	1986	62	2	0	5	0	31
R.B. de Venezuela	1987	82	17	0	0	0	1
Sample average		66	10	8	4	1	11

Source: Cremers and Roseboom 1997.

TABLE 6.8

Institutional composition of public agricultural R&D spending, 1996

	Government			
Country	INIAs	Other	Nonprofit	Higher education
Argentina	51	7	—	42
Brazil	59	23	3	15
Chile	49	18	—	33
Colombia	57	10	24	9
Costa Rica	33	4	28	35
Guatemala	57	—	41	2
Honduras	13	—	84	3
Mexico	44	9	2	45
Panama	81	8	—	11
Paraguay	75	—	0	25
Uruguay	47	14	0	39
Average	54	17	4	25

Source: Beintema and Pardey 2001.
Note: — not available.

important funding sources. Funding diversification is a major challenge for the region, as centralized national or principal agricultural research institutions are the dominant institutions in virtually all countries (see table 6.8).

Budgets and scientific capacity vary widely across the region. Brazil accounts for about half of total Latin American and Caribbean expenditures. EMBRAPA's total budget in the late 1990s was about 60 percent that of the United States Department of Agriculture's (USDA's) Agricultural Research Service. The total combined agricultural research expenditures of Argentina, Brazil, and Mexico are equal to more than 85 percent of the Latin American and Caribbean total. The majority of Latin American and Caribbean agricultural R&D systems, however, are small: 25 of the 32 Latin American and Caribbean countries have less than 200 researchers, about the size of a large U.S. land grant university. The Central American and Caribbean region (12 countries) spent just $39 million in total (the budget of an average size land grant university). The Latin American and Caribbean region employed more than 13,500 full-time equivalent researchers in public sector institutions in 1996, of which Brazil employed nearly 5,000 (36 percent). Argentina and Mexico together employed about another 5,000 researchers; with Brazil, these three countries employed 73 percent of the Latin American and Caribbean total.

There are also large differences in the training level of researchers and in expenditure per researcher. While 82 percent of Brazilian researchers hold graduate degrees, just 20 percent of the Guatemalan and 27 percent of the Honduran researchers do. Only in Brazil and Mexico do more than half of researchers have graduate degrees; only in Brazil and Chile do 20 percent or more hold a PhD. Latin American and Caribbean researchers' educational levels increased steadily between the early 1970s and 1996. There was a six-fold increase in the share of researchers holding a doctorate, and the share holding a Master of Science degree more than doubled, while the proportion holding a Bachelor of Science degree fell from 77 to 33 percent. The region's figures are strongly affected by including the progress that Brazil and Mexico have made in training researchers. Excluding these two countries, the share of Latin American and Caribbean researchers with graduate degrees falls to 55 percent, with just 18 percent holding a PhD.

In a policy context, perhaps the most relevant measure to evaluate investments on agricultural R&D is the social rate of return, as compared to the expected rate of return, on alternate

TABLE 6.9

Estimated rates of return

	Number of estimates	Mode	Mean	Standard deviation
Industrial countries	78	20	66	120
Developing countries	123	40	59	38
Africa	25	30	46	27
East Asia and Pacific	38	45	77	52
Latin America and the Caribbean	56	40	52	27

Source: Roseboom 2003.

uses of public funds. Researchers often cite a surprisingly high rate of return of 40 to 60 percent.[16] In estimating the extent of underinvestment, Roseboom (2003) uses a subset of observations from the extensive compilation by Alston and others (2000) of the evidence on returns to agricultural R&D since 1953. The mode of reported rates of return for the 56 agricultural R&D projects examined for Latin American and Caribbean countries is calculated to be 40 percent and the mean 56 percent (see table 6.9).[17] Even when a conservative estimate for the marginal value of additional R&D investment is used (say 10 percent less than the mode of past investments), there is apparently substantial underinvestment in agricultural R&D in the Latin American and Caribbean region.[18] Moreover, it should be emphasized that under WTO rules, governments have substantial leeway in promoting their agricultural sectors through support of publicly-funded R&D.

In the next section, after reviewing a brief history of Latin American and Caribbean research systems, this chapter turns to several topics in the ongoing development of Latin American and Caribbean region agricultural R&D strategies that merit closer inspection: (a) the public sector's size in R&D strategies; (b) the institutional structure for delivering genetically modified organisms (GMOs); (c) the transition to a complete system of innovation; and (d) how to best address underserved clients and marginal areas.

Latin American and Caribbean national systems: Structure and evolution

Across Latin American and Caribbean countries, agricultural research and extension systems are diverse, but have certain commonalities: they are a relatively young and still evolving set of institutions, influenced by a common set of challenges. Most of the INIAs—the backbone of National Agricultural Research Systems (NARS)—are public autonomous institutions created between the 1950s and early 1970s. The INIA model took previously fragmented research capacities, centered in agriculture ministries, and consolidated them into a single organization with a clear mission and objectives. This new model was widely accepted, triggering a rapid expansion of research capacity (in numbers and quality) during the 1960s and 1970s. Over time, however, many of the INIAs developed into inflexible, politically controlled bureaucracies, and by the early 1990s, most were considered to have become inefficient and ineffective. Experiments with reforming the "INIA model" began.

Centralized INIAs provided basic and applied research, as well as extension services, and the public sector also absorbed the responsibility for seed production, leaving little room for other actors in the agricultural science and technology sector. (The involvement of alternate suppliers of agricultural research, such as NGOs, universities, and the private sector, is of recent origin in most countries.) In this model, extension services acted as a "bridge" between the laboratories and research stations and farmers. Decision making was top-down, often leading to inappropriate technologies and consequently low adoption rates. INIA financing was simple: public budget allocations and international donors funds flowed through the finance ministries to the agriculture ministries or directly to the INIA. Many of the new institutions were initially politically and financially independent, but this autonomy eroded over time. The allocation of resources within the INIAs was often inflexible and incapable of responding to farmers' demands. Funding was often uncertain, administration uneven and politicized, and many systems expanded their scientific staff beyond their financial capacity, leading to low operating budgets. At the same time, few resources were devoted to the human capital development required to keep abreast of modern science.

Much of the impact on agricultural production and productivity can be attributed to the ability of the young INIAs to capitalize on spillovers from the Green Revolution, or more generally from the Consultative Group on International Agricultural Research (CGIAR) international centers. The availability of modern farm inputs also increased dramatically from virtually zero in 1960. Research benefits, however, did not accrue uniformly across countries or even across farmers in a given country, and concerns arose about the distribution of the benefits of new technologies.

During the 1980s, a period of financial crisis and policy reforms, the level of public investment in agricultural research stagnated in most countries, and the public sector's role in providing services, such as seed marketing and extension services,

was drastically reduced. Operating funds per scientist fell significantly, limiting research efforts. The lack of funds constrained the effectiveness of agricultural research systems, creating an image of bloated and inefficient institutions. By the end of the 1980s, new concerns entered the NARS agenda: the environmental and natural resource stewardship, the effect of technological change on small farmers and the rural poor, private sector involvement, and intellectual property rights. New providers of research and extension services appeared, such as NGOs and universities. Tentative reforms were initiated in funding agricultural research to address financial stability concerns and responsiveness to client demands, and several competitive research fund schemes were introduced at the regional and national levels.

In the 1990s, programs to reform agricultural research gained momentum, and Latin America and the Caribbean started to confront additional concerns raised by the globalization process and the opening of economies: agriculture's level of competitiveness and the improvement of food safety, product quality, and value added for competitive export markets. Furthermore, evidence that poverty had worsened across Latin America and the Caribbean during the 1980s raised the visibility of poverty alleviation in the agricultural research agenda. The international institutional agricultural science environment had also evolved. Globalization and new communication technologies reduced the cost of acquiring information, increasing the potential to free ride on international research spill-ins. Balancing this, private and public institutions increasingly sought to protect their intellectual property. While many argued for increased upstream investments in basic and strategic science, there remained both a backlog of unfinished business in addressing the fundamental needs of small farmers and large gaps in the applied and adaptive research agenda.

New institutional players, new scientific potential, liberalized trade policies, and persistent fiscal constraints present a vastly more complicated decision-making environment for managing research in the 1990s. Reforms of the INIAs initiated in the 1980s included efforts to support new institutional actors, competitive research funding, private sector participation, extension decentralization and contracting, and public-private partnerships. A more complex and comprehensive view of innovation systems promoted greater integration among research, extension and education organizations—referred to variously as an agricultural knowledge and information system (AKIS), or even more broadly as a national agricultural innovation system (NAIS). The NAIS model expands the system concept by recognizing wider sources of innovation (including farmers and foreign suppliers) and places increased importance on feedback linkages among research, development, and uptake of technology.

Response to the new vision for technological change has resulted in an environment where INIAs, although still dominant, are being challenged to link their efforts to a variety of other service providers that includes NGOs, universities, and the private sector, including farmers and farmers association. These pluralistic research systems promote the exploitation of complementarities among institutions. This represents a significant change in attitude for the INIAs, which had often viewed the private sector as competitors. Because the emphasis is on knowledge and information, education becomes part of the innovation system. At the same time, efforts are being made to implement new and diverse forms of research funding, which is increasingly "delinked" from provision of products and services. Specialized funding bodies, such as research councils, are setting these broad priorities; these funding bodies increasingly allocate funds through competitive and contractual mechanisms, encouraging wider participation, competition, efficiency, and accountability (Byerlee and Alex 2003).

Despite the ongoing effort to reform and restructure Latin American and Caribbean agricultural research, the most common structures remain the INIA model in larger countries and the ministerial department model in smaller countries. A number of other research suppliers can now be found, but the quality of these institutes varies widely, and there is often a lack of coherence and cohesion among the efforts of the various research providers. The average share of public agricultural research capacity of the principal research agencies (either INIAs or ministerial research departments) is 46 percent. The university research share is significant at 28.1 percent, but tends to be lower in the smaller countries. In the mid-1990s in developed countries, about 43 percent of the public research was done at universities, while only 10 percent was in Africa in 1991 (Pardey and Beintema 2001). Latin American and Caribbean countries have moved in the direction of the developed countries, with universities playing a greater role in agricultural innovation under the broadened AKIS concept. The share of agricultural research conducted by nonprofit agencies is small at just 4.6 percent, but it is much higher in a few of the smaller countries. The private sector's intramural agricultural research capacity and related investment are limited, probably around 5 percent of total agricultural research expenditures, and the bulk of pri-

vate investment occurs in Argentina, Brazil, and Mexico. Applying the same definition of private agricultural R&D to the developed countries as used in Latin America and the Caribbean (that is, intramural R&D undertaken by private businesses in the agricultural sector), yields a private sector share of 11.6 percent.

Public sector size and research strategies

It is probably useful to separate Latin American and Caribbean systems into three groups, as follows:

1. The first group would include the 25 smallest agricultural research systems. These are about the size of a single U.S. land grant university, but are at a large disadvantage to U.S. universities in terms of training their scientists.
2. The second group of countries has an increased capacity across the research spectrum, but has large areas of limited expertise. This includes Chile, Colombia, Costa Rica, and Uruguay.
3. Finally, there are the "giants" of the region, Argentina, Brazil, and Mexico, that have significant basic research capacity, a higher number of PhD trained scientists, well-staffed universities, and scientists that regularly participate in international scientific congresses.

Moving from basic research to technology delivery, both potential spillovers and research costs and sophistication fall as research becomes embodied in farm technologies. The ability to exclude others from basic research findings is generally assumed to be low, although there are important exceptions to this. The agroclimatic specificity of innovations also increases closer to arriving at the technology applied on the farm. Historically, scientists at universities and nonprofit research institutes in industrialized countries have done the bulk of basic research. This is still true, but private sector firms, which are more inclined to protect discoveries than public institutions, have also made large investments in upstream research as they search for strategic advantage in developing biotechnology products. Basic research findings are routinely published in international journals and presented at international conferences, facilitating knowledge spillovers, and such results often have worldwide applicability because they are not sensitive to climate.

Strategic research is a broad category, including efforts that link basic and applied research related to farming, but that do not directly generate farm technologies. A plant-breeding example would be prebreeding research that searches for genetic disease resistance. Prebreeding increasingly makes use of genetic engineering discoveries, but does not directly produce farm technologies. It provides crucial inputs for varietal development, but would generally be useful to a broader group of environments than varietal development research. The initial wheat and rice semi-dwarf varieties are an example of prebreeding products. These varieties were useful across many climatic zones and were directly planted during the early Green Revolution. The genes' main contribution, however, was as a genetic input that plant breeders used around the world to increase yields of local varieties.

What do the characterizations of spillover potential and institutions suggest about the goal of achieving efficiency in Latin American and Caribbean research? What are the potential contributions of national, regional, and international institutions in providing the range of needed research outputs? And what are the institutional obstacles to coordinating research across countries, sectors, and institutions? The prescriptions vary slightly by institution size, but have much in common.

Small-scale systems lack human capital, not just to conduct basic research; they must also borrow virtually all kinds of research, including finished technologies. These countries cannot hope to adequately staff important research on all agricultural commodities with a full range of required research disciplines. A significant challenge for these countries is to increase the training of their agricultural researchers and to retain the scientists with advanced degrees in the research sector. The low numbers of PhD and MS level scientists leave many countries below the threshold level of scientific talent needed even to competently screen and adapt technologies developed elsewhere. But it is clear that the bulk of useful agricultural technologies will be developed abroad and adapted to local conditions. In other words, the focus of these countries must be on accessing direct technology spillovers, from whatever source.

The second tier countries are in a much better position to take advantage of spillovers because they have a greater number of researchers with advanced training who are able to screen foreign technologies when given access. These countries will still be dependent on imported technology in many areas, but would certainly be able to perform adaptive research for virtually all commodities. They should also be capable of conducting strategic research and some basic research in nationally important commodities.

The top tier countries are able to mount credible research programs in all areas, including basic research. A significant number of their scientists are tied to the international scientific community, and the number of researchers is adequate to cover all important commodities and disciplines. Nonetheless, efforts to take advantage of spillovers represent a key component of technical change in the future.

There is little indication that a significant amount of research information or technology is currently passing directly between countries. Indeed, Traxler and Pingali found that just 5 percent of wheat and rice varieties released by developing countries worldwide were directly transferred between national breeding programs without being first adapted by either CIMMYT or IRRI. This leaves the CGIAR centers, which have been important providers of improved germplasm (and to a lesser extent improved agronomic practices), and the international private sector as important technology sources for small countries (Byerlee and Traxler 1995; Evenson and Gollin 1997). Intra-regional networks and scientific congresses organized to facilitate sharing of research findings are a third source that has been important in some research areas. The Central American regional maize and bean programs are examples of these programs. Even these programs, however, are largely a conduit for moving International Agricultural Research Center (IARC) germplasm (Sain 1998; Viana 1998), so they might most appropriately be considered to be important compliments to CGIAR centers' activities. Regional networks appear to have great potential merit. Considerable work remains on addressing complex institutional issues of funding and operating such regional systems before they can be considered sustainable.

How might the small countries take better advantage of research spillovers? An obvious first step is to improve the training of their agricultural researchers. Another basic step is to develop improved institutional arrangements for sharing intellectual property. The institutional norms for sharing research across the public sector are not well established and are becoming more complex as concerns for intellectual property rights become more prominent and as public sector research budgets come under increased pressure to seek alternative funding sources. Cross-licensing technology between private sector firms has become a routine and common practice as a means to speed R&D. Yet few such compensation schemes exist anywhere in the world for public sector sharing. Public-private agreements may be more common than cross-border technology sharing agreements among public sector institutions.

Many public sector scientists and administrators lack the experience, understanding, incentives, and authority to negotiate access to technology developed by either public-private or private sector institutions. Few research budgets allocate funds for the purchase of rights to use technology held by other institutions (for example, for a breeding program to buy access to a transgene from Monsanto, rather than to invest in research to develop an alternative). As a result, research efforts are duplicated among institutions, technology development timelines are lengthened, and access to useful technology is restricted. This problem is not unique to Latin American and Caribbean and it seems to exist in most countries. The lack of movement in negotiating technology access stands in striking contrast to the frequency with which private sectors rivals enter into sharing agreements (Kalaitzandonakes 2000). The private sector has accepted the impossibility of developing all technology components in a single firm, and has accepted the imperative of compensating other actors for technology access. On the other hand, public sector institutions have been very slow to evolve access arrangements with institutions in either the public or private sector.

The institutional structure for delivering GMOs—existing and future needs

Biotechnology deployment resembles nearly all other agricultural technologies—for adoption to occur there must be a convergence of technology attributes, infrastructure for delivering the technology, and farmer conditions. To date, the realization of biotechnology research benefits have been concentrated in just three large countries that are exporters of major food crops: Argentina, Canada, and the United States. The primary explanation for this geographic concentration is the dominance of the private sector to date in the delivery of biotechnology innovations. These countries have huge seed markets and similar agricultural systems. The private sector naturally has focused their R&D effort on those markets with the greatest sales potential for seeds. Biotechnology's potential has been most notably unfulfilled with regards to farmers in small countries and for tropical agriculture. Biotechnology holds great promise as a new tool in the scientific toolkit for generating applied agricultural technologies for these groups. At present, the challenge is to design an innovation system that focuses this potential on the problems of developing countries (Pingali and Traxler 2002) (see box 6.1).

BOX 6.1

Welfare effects of the introduction of genetically modified organisms in Argentina and Mexico

Transgenic Bt cotton was first grown in Mexico and the U.S. in 1996 and subsequently introduced in Argentina, Australia, China, Colombia, India, Indonesia, and South Africa. The first Bt varieties were introduced commercially through a licensing agreement between Monsanto and the leading U.S. cotton germplasm firm. Herbicide tolerant (HT) varieties were also introduced in the United States in 1996, and "stacked" varieties—containing both the Bt and the HT events—appeared in 1998, but these varieties have not been significantly adopted in any other Latin American and Caribbean country. Bollgard™ cotton varieties have been accepted rapidly in areas where there are high infestation levels and economic losses from pests, but adoption has been low and restricted to large-scale farmers in Argentina due to the large price premium charged for transgenic seeds (Qaim, Cap, and de Janvry 2003).

Also in 1996, RR (Roundup Ready) soybeans were commercially released in Argentina and the United States. The sale and use of RR technology are protected in the United States through patents and sales contracts with farmers, but neither form of intellectual property protection is used in Argentina, where RR soybeans are widely available from sources other than Monsanto and farmers pay virtually the same price as for conventional varieties. Argentine farmers are legally allowed to use (but not sell) farm-saved seeds, but they are not required to sign special purchase contracts, as in the United States. The sale of pirated seed is widespread, including cross-border sales in Brazil and Paraguay. By 2003, more than 95 percent of Argentine soybean area was cultivated with RR seeds, and this area has nearly doubled since the introduction of RR technology. The Argentine national seed institute, INASE, estimated that in 2001, farm-saved seeds accounted for 30 percent of all soybeans planted. Although sales of farm-saved and other uncertified materials are prohibited under law, unauthorized sales are estimated to account for another 35 percent of total seed consumption. (The remaining 35 percent are certified seeds sold by authorized companies.) Weak intellectual property protection and the widespread use of farm-saved and black market seeds depress prices in formal markets. In January 2004, Monsanto announced that they were ceasing seed operations in Argentina due to widespread black market sales (Burke 2003). If farmers in Argentina, Brazil, and Paraguay were paying the same per hectare royalty as in the United States, the industry would be collecting nearly $200 million annually in RR technology fees.

Field level studies of Bt cotton performance were completed in Mexico (Traxler et al. 2003) and Argentina (Qaim and de Janvry 2003) and in several other countries (Fitt 2001; Ismail et al. 2001; Pray et al. 2001; Qaim and Zilberman 2003; Falck, Traxler, and Nelson 2000). Bt varieties had higher yields, were more profitable, and saved on pesticide expenditures in both Mexico and Argentina. Traxler et al. estimated the aggregate impact and the functional distribution of benefits from the introduction of transgenic varieties in Mexico on benefits to producers and industry. To calculate benefits, the study used estimates of farm-level cost savings and made use of estimated world cotton supply and demand deriving from an economic surplus model (Alston et al. 1995). A similar framework was used in studies of Bt cotton in the United States (Falck, Traxler, and Nelson 2000) and China (Pray et al. 2002). Part of the motivation for these studies has been that, except for a few varieties in China, Bt transgenics have all been patented private sector innovations, and patent holders may hold some monopoly power over pricing. Certainly, the transgenic seed price has been higher than that of conventional seed, and technology fees are charged on top of such high prices for genetically modified seeds.

The empirical studies that were completed find that the benefits from biotechnology innovations have been widely shared among consumers, producers, and industry.

The average shares of total benefits from the introduction of Bt cotton in Mexico's Comarca Lagunera region were 16 percent for germplasm suppliers and 84 percent for farmers (Traxler et al. 2003). The per hectare change in variable profit accruing to farmers varied widely between the two years, with an average figure of $335.45. Therefore, for the two years, an estimated total of more than $6 million in benefits was produced. In this calculation as in the U.S. welfare calculations, the entire amount attributed to Monsanto is not truly a net benefit, because costs such as seed distributor compensation, administration, and marketing were not accounted for. The $1.5 million revenue from seed sales is not a large

BOX 6.1 ***continued***

sum for a company such as Monsanto with $5.49 billion in annual revenue. The large annual fluctuations are largely caused by variability in pest infestation levels; in years of heavy pest pressure, Bt cotton produces a large advantage over conventional cotton varieties. Because Mexico grows a small share of the world's cotton, there was no effect on consumers' benefits.

RR soybean yields are not significantly different from conventional soybean yields in either the United States or Argentina. The farm level benefits of RR soybeans are generated primarily through reduced herbicide, tillage, and management costs. Many farmers switched to low-till or even no-till cultivation practices after adopting RR soybeans and machinery; labor costs are also lower due to the reduced time needed to harvest the cleaner RR soybean fields (Doanes 2001; Qaim and Traxler 2003). In Argentina, the total variable production cost is about 8 percent ($21 per hectare) lower for RR soybeans than for a conventional crop. In 2001, RR soybeans created more than $1.2 billion, or about 4 percent of the value of the world soybean crop, in economic benefits at the global level. The largest share of overall benefits went to soybean consumers, who gained $652 million due to lower prices. Soybean producers received net benefits of $158 million, and biotechnology and seed firms received $421 million as technology revenue. (Assuming research, marketing, and administration costs amount to 33 percent of technology fee revenues, the monopoly rent would fall to around $280 million [or 26 percent of total surplus].)

In 2001, soybean producers in countries where RR technology was not available faced losses of $291 million due to the induced decline of about 2 percent ($4.06/metric ton) in world market prices. This underlines the fact that national restrictions to GMO technology access can bring about considerable domestic farm sector taxation. A case in point is Brazil, the second largest soybean producer in the world. RR soybeans have now received official approval for commercialization in Brazil. According to industry estimates, farm level benefits in Brazil could be similar to those in Argentina (Paarlberg 2001). Argentine farmers received spillover surplus of more than $300 million by 2001, compared to $145 million going to U.S. farmers. The RR technology was developed in the United States, with a small amount of adaptive plant breeding done by the private sector in Argentina. Spillover benefits to Argentine farmers were large despite a minimal in-country biotechnology research capacity. Farmers in developing countries have much to gain when they are given access to suitable foreign technologies.

Monopoly rents for private firms in the United States were large, but because of weak intellectual property protection in Argentina, technology revenues there are much smaller, accounting for just 8 percent of the total Argentine surplus. Falling prices for RR seeds and a growing informal market will further reduce this revenue stream over time. These results also show that private firms can gain something from their innovations even without effective patent protection. Given the large market size, Argentina will remain interesting for foreign seed companies, but intellectual property protection must be improved beyond its current state.

Source: Acquaye et al. 2004.

The creation of a commercially viable GMO is the result of combining the products of two distinct scientific steps—a biotechnology step and a plant-breeding step. The biotechnology step produces a genetic event or gene transformation that is useful in solving an economically important agricultural problem. The gene must then be combined with an adapted crop variety to create a viable commercial GMO. The two steps are largely separate scientific enterprises and need not occur in the same institution or even in the same country. For example, Monsanto has introduced the most commercially successful genes to date, yet it has only recently acquired capacity in traditional plant breeding, and has maintained its conventional breeding capacity in separate subsidiaries. All Monsanto GMOs use germplasm from subsidiary or licensee seed firms. On the other hand, the world's leading marketer of GMOs, Delta and Pineland Seed Company (D&PL), has never had significant biotechnology research capacity. D&PL is a modest size seed company with eight U.S.-based cotton breeders and three breeders in other countries.

The type of scientific capacity required to mount a successful biotechnology research program is fundamentally different from that needed for competitive plant breeding. To date, multinational life science firms have developed most of the commercially successful genes. Discovering useful genes, transferring them to the intended plant species and achieving an adequate level of expression of the alien gene in the new plant host is advanced biotechnology science. Biotechnology science is evolving rapidly, with a steady stream of process innovations. For an institution to compete in this market requires large investments, cutting-edge scientific talent, and the skilled legal counsel needed to negotiate intellectual property hurdles. Success in discovering a marketable event is also very uncertain, with many more failures than successes. The end product of the biotechnology step is a crop variety with an adequate level of expression. Transferring the gene to the initial or receptor variety is accomplished using one of several biotechnology protocols. Subsequent transfers to other varieties of the same crop are done using traditional plant-breeding techniques. Because the receptor variety is chosen on the basis of its characteristics in expressing the gene, rather than its superior agronomic performance, the plant-breeding step is essential to achieve a GMO that will be successful in the market. The plant-breeding step for self-pollinating crop varieties is straightforward. The receptor variety is crossed with a leading commercial line, followed by three or four backcross generations and another three "selfing"[19] generations to attain a genetically stable variety. Using greenhouses and shuttle breeding, it is possible to produce three generations per year, so a marketable GMO can be produced from a receptor line in two to three years.

The plant-breeding step of creating a commercial GMO from a receptor GMO is quicker, easier and more certain than the development of a commercially successful conventional variety from a pool of elite lines, and it can be done at a fraction of the cost. As a result, the genes can be transferred at low cost to a large number of locally adapted varieties. The ease of gene transfer through conventional breeding is the reason that countries with relatively small areas, such as cotton in Argentina and Mexico, became attractive commercial markets once they established procedures for biosafety clearance.

There are several necessary conditions for a multinational life science firm to enter a country. Currently, the primary obstacle appears to be the unavailability, cost, and uncertainty of regulatory clearance. A more inclusive list of market entry conditions might include the following: (1) A gene that adds market value; (2) access to adapted germplasm; (3) a centralized, transparent, science-based regulatory process; (4) the ability to protect intellectual property; and (5) acceptance of GMOs by farmers, regulators, processors, and legislators.

The private sector–led progress in biotechnology has been financed by corporate debt and equity, commercial sales, and through specialized "start-up" firms using venture capital. The public sector has played a role in supporting basic research. The total U.S. federal and state public sector budget for Agricultural Research Service and the land grant universities for agricultural research was more than $2 billion. Developing country potential to finance biotechnology investments occurs on a vastly smaller scale. Incentives are weak for private sector investment even in large developing countries because of uncertainty about the potential to enforce intellectual property rights. Public sector research efforts are also small relative to the United States. James (2003) estimates that 96 percent of the $4.4 billion invested globally in crop biotechnology in 2001 occurred in industrialized countries, and that the private sector invested just $36 million in developing countries compared to $3.1 billion in industrial countries. By comparison, CGIAR, the largest international public sector source of agricultural technologies, spends less than $250 million annually on *all* plant improvement R&D and only about $25 million on biotechnology (Byerlee and Fischer 2001).

Only in China has the public sector been a significant source of biotechnology innovation. To date, no GM crops have been introduced into tropical regions (Pray and Naseem 2003). The geographic and crop focus of private sector biotechnology R&D and innovation are unlikely to change soon, and the innovation rate in countries that do not have large seed markets will undoubtedly continue to lag. A vital question then is who or what institution will develop GM crops for developing countries, including the majority of countries that are small both in terms of seed market potential and in terms of scientific capacity? At present, no institutional infrastructure exists that has both the resources and incentives to focus on delivering a stream of biotechnology innovations to developing countries (see box 6.2).

BOX 6.2

Genetically modified organism generation options in tropical Latin American and Caribbean countries

How might the institutional and scientific environment for generating and delivering biotechnology evolve in a direction that makes it possible to deliver transgenic products to developing country farmers residing in tropical countries? Consider the four institutional possibilities outlined below.

Each country produces its own GMOs

This is the least likely of the institutional options. The capacity needed to use technology is very different from the capacity required to generate technology. Even large countries such as Argentina and Mexico that are using GMOs lack the capacity to generate a stream of GMOs targeted at their individual domestic agricultural problems. The GMOs that they are using were developed by Monsanto for the U.S. market, so the only research needed was adaptive plant breeding to transfer the Bt and herbicide tolerance genes to local commercial varieties. Many small Latin American and Caribbean countries lack the capacity for even this type of adaptive research.

CGIAR centers lead delivery

This is an intriguing institutional possibility given the success of the CGIAR centers in distributing the semidwarf wheat and rice technologies that induced the Green Revolution. But the Green Revolution and the Biotechnology Revolution are delivering vastly different technologies into vastly different worlds. The dwarfing genes were freely shared among scientists in many countries without regard for intellectual property rights, were widely adapted, easily moved to adapted germplasm at low cost using simple scientific methods, and faced few phytosanitary concerns. The CGIAR centers are not heavily invested in biotechnology research capacity at present with a total annual expenditure of perhaps $25 million, and have faced stagnant or declining budgets in recent years. Furthermore, the CGIAR system is inexperienced in negotiating and accessing protected intellectual property—an absolute necessity for any institution to play the role of developer or broker of useful biotechnology products. It is unreasonable to expect them to be a major supplier of biotechnology research for developing countries.

Regional NARS take biotechnology leadership

This institutional possibility might take the form of a large NARS (such as in Brazil, Argentina, or Mexico, or a coalition of country institutes) emerging as the supplier of biotechnology research for all countries in the region. This would be logical given the similarity of production constraints across countries. The scale and scope economy advantages of clustering efforts for countries with similar agroclimatic conditions are significant, and each of these countries has significant research capacity in both basic and agricultural science. But Brazil has only recently approved GMOs for commercial use and is estimated to be spending only $15 million annually on biotechnology research (James 2003). (China is the world's only public sector research system that has delivered a GMO product to its farmers.) There is no indication that the public sector in any other country will deliver a transgenic to its farmers in the near future (and no other country has yet benefited from biotechnology made in China). The lack of institutional arrangements for sharing intellectual property (IP) is a large hurdle to be overcome. Contrary to the pace at which private sector companies now share IP among firms, there is scant evidence from anywhere in the world that indicates that public sector institutions have the flexibility or that public sector research administrators are motivated, or have the authority, to achieve such exchanges. This implies that a radically new mindset and new institutional arrangements would need to arise before sharing IP could become sufficiently routine that smaller countries could depend on their large public sector neighbors to supply useful research outputs.

At present, outside of germplasm being shared within the CGIAR networks, there is very little cross-border sharing of technology between public sector institutions, probably due to a lack of incentives for public officials to negotiate such arrangements, but also probably due to the implicit competition among countries in international commodity markets. For example, it is not clear whether Brazilian Agricultural Ministry officials would favor allowing research administrators to share technology that would improve soybean technology in Argentina, Paraguay, or Bolivia.

Private sector delivery

Private sector delivery is the tested model, having delivered current GMOs. The private sector accounts for more than two-thirds of agricultural biotechnology investments at present, although investment in developing countries is negligible. At least three major obstacles may prevent this from becoming a viable option for the near term. First, transaction costs are very large for market entry in each country. In most countries obtaining biosafety clearances is either impossible or so uncertain and expensive that the private sector does not consider market entry to be a good business risk. The list of Latin American and Caribbean countries with functioning biosafety committees is increasing, but until there is some type of regional harmonization and sharing of biosafety information, the regulatory transaction costs are entry barriers for most countries. A second obstacle is the difficulty of protecting intellectual property rights (IPR). The experience to date with IPR enforcement in soybean, maize, and cotton GMOs worldwide is mixed—protection has been good in some countries, difficult in others, uncertain in most. The third—and possibly the most difficult—obstacle is the absence of functioning seed markets in most countries for most crops. With the exception of maize, cotton and vegetables in a few countries, seed markets are very thin, making it difficult to deliver GMOs to farmers.

The combined effect of these obstacles is an environment of weak incentives for private sector investment in developing countries—certainly nothing like the business potential that fueled the discovery of existing GMOs in the United States. At present then, the developing world suffers from the absence of large GMO markets with secure access. The one scenario under which the private sector could become a reliable source of biotechnology innovations for developing countries is the one in which the large market countries (India, Brazil, and China) become "GMO friendly." If Brazil were to achieve a stable regulatory and IPR regime, and if GMO products were accepted by Brazilian consumers, the private sector would likely be prepared to make substantial R&D investments in GMO development for Brazilian agriculture. Any products developed for Brazil would become available for neighboring countries that have attained the necessary biosafety regulatory and IPR enforcement capacity. Once the private sector would have developed useful products for Brazilian farmers, it would begin marketing them in similar agroclimatic countries. However, even if this scenario were to develop, the prospects for pureline crops would remain uncertain.

Source: Acquaye et al. 2004.

Research policy and the transition to a more complete innovation system

By any measure, agricultural R&D investments have historically been an efficient use of funds, and by and large have had the type of social and economic impact that international donors seek. Over the past decades, the vision for Latin American and Caribbean agricultural technology has broadened from the simple objective of creating a public research system dedicated to producing more food, to a broader vision of creating a system capable of using scientific knowledge to improve the lives of rural residents. Serious efforts to increase rural productivity have been underway in Latin America and the Caribbean for about 50 years, but in many countries the effort is more recent. Knowledge about how to structure and support research institutions, the impacts of technological change, and how the rural and urban sectors are linked have been generated along with the scientific and technical advances.

Despite the progress that has been made, a number of institutional flaws are apparent, and even successful institutions must be willing to change as the world around them changes. The traditional, centralized NARS are often deficient in basic science capacity, lacking appropriate physical and human capital. Inadequate downstream linkages to small farmers and to residents of remote rural areas (generally the poorer population) are also a major concern. Most NARS have no formal mechanism for research priority setting. Research allocations are often the result of historical precedents, changing little over time. Individual researchers or research stations control few resources, so they have little flexibility even when addressing local needs.

Experiments in institutional reform show some promise for addressing some important challenges facing Latin American and Caribbean systems; solutions for other problems remain less clear, however, challenging the next generation of

scientists to continue the reform movement. There is also no doubt that today's scientific, legal, social, and economic environment is dynamic, complicating the search for solutions. Next, we turn to some of the challenges that are common across many of the systems discussed in this section.

Funding diversification

Few national research systems are assured of maintaining public funding at historic levels. Several countries have already forced NARS to take significant funding cuts. A few countries may be able to increase funding, but the majority must be concerned with avoiding cuts as national governments shift budgetary priorities away from agriculture. Political support for increased funding depends on reforming public research organizations to address the problems of scarce operating funds, inappropriate human resource policies, and weak performance incentives.

Analytical capacity for priority setting is generally weak and subject to political influences, and research resources are largely fixed in current uses. A variety of new funding mechanisms, such as the commercialization of research products and services, levies that farmers pay, and environmental funds, have been attempted to supplement public funding. There has been a strong trend in many public research organizations to commercialize research products and services. While sometimes providing much needed operating budgets, this strategy often undermines private markets and leads to conflicts with the broader objective of public organizations to maximize benefits to society at large. Furthermore, the experience of the U.S. public research universities suggests that only a handful of institutions are likely to even cover the legal costs of administering an effort devoted to capturing royalty income.

Whatever revenue is captured comes with a very large social cost of diverting the research focus away from creating public goods, toward maximizing appropriable economic surplus. It is therefore not recommended that public institutions presume that royalties are a secure or costless funding source. A more appropriate intellectual property management objective would be to use whatever means available to ensure that the product gets to market. In some cases, placing the technology in the public domain for free use will create the largest societal surplus; in other cases, exclusive licensing may be required. The private sector is obviously a key ally in this effort. Producer groups are a funding source with greater potential, and one that is more consistent with the public research mission. The experience with producer funding in Chile, Colombia, and Uruguay also suggests that this can be an important funding source when properly organized.

To motivate client groups to contribute to research funding will require deep reforms that create flexible and efficient "autonomous" research organizations that are run along private sector lines, with independent governing boards representing key stakeholders. Greater flexibility in directing research efforts must be combined with increased accountability to promote results-oriented institutions and the development of a political constituency for agricultural research. This involves better links and accountability to clients, improved monitoring and evaluation of research impacts, and better public relations. Movement toward this funding mechanism fits very well with the establishment of competitive funding mechanisms. Building the trust of producer groups is a long and slow process, but one with a very large potential payoff for farmers and researchers. Competitive funding schemes allow research councils and ad hoc bodies to set broad priorities; these groups are insulated from the bureaucratic methods characteristic of INIAs.

Diversification of research services suppliers

The centralized INIAs still dominate Latin American and Caribbean agricultural research performance and are likely to maintain an important role in the future. For Latin American and Caribbean countries to move toward a more comprehensive innovation system will require a severing of the historic INIA monopoly of funding and of its research mandate. Public research agencies will remain central to providing coherence to many research efforts. Strategies, however, must enhance, not restrict, participation by the full range of research providers, including universities (domestic and foreign), private firms, NGOs, international research institutes, and farmer organizations. To encourage pluralism and competition, research funding must be "de-linked" from the provision of research products and services. To accomplish this, research funds will need to be available through competitive and contractual mechanisms to encourage wider participation, competition, efficiency, and accountability. Decisions on financing of public goods can often be separated from responsibilities for producing them and, even when public financing of services is justified, the private sector (for-profit or not-for-profit) is often more efficient in delivering the product. Initial experiences show that competitively contracting science and technology services divides responsibility between the public and private sectors and improves the quality, accountability, and impact of services. The concept of contracting for

research services, rather than creating an in-house capacity, is a new idea for research managers.

Partnerships between INIAs and other institutions allow for specialization, exploit institutional comparative advantages, and may reduce costs. Partnerships are often particularly useful in linking institutions with differing competitive advantages for work at different levels of the research continuum, such as having universities perform basic research, international research centers conducting strategic research, and NGOs and producer organizations providing adaptive research. Because of their agricultural sector experience, their network of field research stations and their links to extension services, INIAs can link the components of the expanded set of research providers. The most efficient and effective division of labor for research will vary across countries, depending on the strength of existing institutions, and it will require time for productive working relationships to evolve.

Clear incentives for collaboration must be established to encourage partnerships that integrate the various players into an innovation system with the capacity to employ science to serve rural areas. There is likely to be a very high return to efforts to form regional and international alliances. Links to the CGIAR centers have generated large benefits in many Latin American and Caribbean countries, and as the capacity of the NARS increases, the ability to use CGIAR knowledge and technology will also increase. Many commodities are not covered by CGIAR (for example, horticulture, tropical fruits, and coffee), so research organizations must seek a broader range of partners. Regional research initiatives led by regional or subregional agricultural research organizations are especially important in sharing research costs and in attaining a critical scientific mass for many small countries.

Integrating public and private sector efforts

The Latin American and Caribbean public and private sectors have been very poorly articulated. In some countries, private sector actors, particularly multinational companies, engender suspicion and misunderstanding about the potential for farmers to benefit from private provision of services. Although largely a phenomenon of the past, the public sector has at times been in competition with the private sector or has tried to monopolize services such as seed production and distribution that the private sector is better equipped to provide. There are many services that are now absorbing public resources that could be divested to the private sector with no drop in service to farmers. The transition to more cooperative public-private relationships will require attention to a number of institutional details, especially in the area of contracting and sharing of intellectual property. The capacity to devise strategies and procedures to administer partnerships is low in most systems, and countries have been slow to invest in improving this capacity. This is an area where there may be large regional economies of scale and room for working jointly to set regional strategies and legal principles to engage the private sector.

Strategies to access biotechnology

Biotechnology and information and communications technologies are providing new tools to address the needs of the rural poor. Strategies to take advantage of this potential will vary with country scientific capacity and commercialization level of agriculture, but all countries will need to make decisions on a core set of issues. All countries will need to strengthen their policy and regulatory frameworks for intellectual property rights, biosafety, and food safety. All countries will need to improve their analytical capacity to devise suitable trade strategies and policies for genetically modified products and for accessing the new technologies that must be developed. It is also crucial that countries be able to assess the costs and benefits from biotechnology science investments.

To date, public sector biotechnology investments have provided producer benefits in only a handful of countries. The highest return on biotechnology investments at present lie in developing the ability to assess economically the merits of particular biotechnology investment strategies and in understanding how to free-ride on private sector investments. Despite the immense promise held by biotechnology, countries should proceed slowly with investments in biotechnology research capacity. Such investments should be seen as complementary to the required precursor investments in proven conventional research areas such as plant-breeding capacity and in support for needed regulatory infrastructure. The majority of countries in the region are small, and few have biosafety systems that are fully functional. Even fewer have the capacity to deliver seeds of improved varieties (GM or conventional) to all of their farmers in all crops.

Competitive grant programs

Several countries have begun to experiment with institutional alternatives to the prevailing centralized NARS model for generating and delivering improved agricultural technologies. The most prominent of these alternatives is the competitive grants scheme (CGS) for agricultural

research and extension programs that began in the late 1980s and 1990s. The World Bank and the IDB promoted these schemes as a means of addressing several shortcomings of the centralized research institute model. CGSs are currently active in Colombia, Ecuador, Peru, República Bolivariana de Venezuela, and several countries in Africa and Eastern Europe. The institutional structure of the CGS projects varies from country to country, but they have been designed to address three important reform issues: (1) input from rural clients can be directly incorporated into funding decisions through client representation on subproject boards of directors; (2) increased availability of operating funds for scientists; and (3) improved linkages among scientists at different institutions.

This last mechanism has the potential to improve upstream and downstream linkages. Upstream linkages may be improved by allowing financial resources to flow to universities where basic science research capacity resides. On the downstream linkages side, NARS must now respond to client needs or face the prospect of diminished funding. Proposal criteria can be written to require that principal investigators come from more than one institution. This mechanism can be used, for example, to draw university faculty in the biological sciences into research on agricultural problems through joint projects with field agricultural scientists. The need for strengthened backward linkages has increased in light of advances in the potential for new scientific discoveries, including biotechnology to improve rural productivity.

In some sense, the CGS can be thought of as a tool of "backdoor reform." Political pressure from larger farmers, larger political movements, or favors requested by local politicians can easily sideline efforts to restructure or reorganize NARS; as a result, often only tinkering with NARS occurs and its deeper structural shortcomings are not addressed. Reform is facilitated under donor-sponsored CGSs because funds are additional to existing NARS budgets and resources do not need to be diverted from existing programs. Developing sustainable funding sources is the next challenge facing CGSs.

Connecting with underserved clients and marginal areas

One motivation for public funding of agricultural R&D is to allow NARS to serve small and remote farmers who lack access to both innovations and the means to exploit them. Of particular concern are farmers in marginal areas, which are characterized by geographic isolation, poor market access, and low-productivity biophysical environments. Because the poverty incidence and severity are often higher in these marginal areas,[20] they warrant special attention. One set of innovations that have shown proven results in improving productivity in marginal areas comprises modern varieties of crops. While the benefits of modern varieties were initially concentrated in high-productivity agricultural areas, Byerlee and Kelley (2004) report that during the 1990s, the adoption of modern varieties had a major productivity impact in marginal areas (see table 6.10). Another set of innovations with good potential for marginal areas suffering drought risk and moisture deficiencies are natural resource management (NRM) technologies that manage soil and water better. These technologies have proven effective in experimental conditions, but there is limited evidence of their successful adoption.[21]

Marginal areas are typically difficult to access, making extension services very difficult and expensive to provide, and consequently, many NARS have not been effective in reaching small and isolated farmers. Considering the Brazilian experience, Dahlman and Frischtak (1993) conclude that, while the results of EMBRAPA's R&D efforts have had some success in expanding production in less fer-

TABLE 6.10

Estimated average annual yield growth due to modern varieties for selected crops and regions in marginal areas with poor market access

Crop	Region	Area planted with modern varieties in 1998 (%)	Average annual yield growth from modern varieties, 1990s (%)
Cassava	Latin America	7	0.24
	Asia	12	0.49
	Africa	18	0.77
	All regions	—	0.64
Potatoes	Latin America	84	0.69
	Africa	78	1.10
	All regions	—	0.85
Beans	Latin America	20	0.28
	Africa	15	0.43
	All regions	—	0.33
Maize	Africa	17	0.20

Source: Byerlee and Kelley (2004), from Evenson and Gollin (2003).
Note: — Not available.

tile areas and in introducing new seed varieties (for coffee, cotton, maize, rice, tobacco, and wheat), the diffusion of research results, which is not necessarily EMBRAPA's responsibility, has been limited mostly to producers in better-endowed regions. This is due in part to the few resources devoted to the adaptation and screening by on-farm testing of new technologies and innovations prior to their dissemination to resource-poor, smaller-scale farmers in the country's less developed regions. Research centers often lack the mandate, the motivation, and the human and physical resources for technology diffusion to this group of producers. Extension has yet to be recognized explicitly as an important function of the research establishment.[22]

One challenge facing any innovation system is to have a clear strategy on the information flow from its source to the ultimate users, thereby delineating responsibilities along the chain, but unfortunately, there has been very little thinking with regard to this issue at the Latin American and Caribbean policymaking level. Farmers in marginal areas are difficult for extension agents to reach and serve due to poor transport and infrastructure links, their low education levels, and their limited access to complimentary inputs. At the same time, tight budgets and numerous potential clients require extension agencies to ration direct contacts. Facing these constraints, extension agents are more likely to allocate their efforts to larger, wealthier, and more innovative farmers in accessible areas, because they are less expensive to serve and more able to exploit extension services. This incentive structure results in underserving farmers in marginal areas, requiring NARS to take targeted action to serve those farmers, for example, by stratifying extension efforts by client types, based on ability to pay for the service.[23] Larger commercial farmers can both better evaluate the benefits of extension services and have the ability to pay a greater share, if not all, of the service's costs.

All farmers desire better market intelligence and support to determine which crops can be sold profitably abroad and which are likely to compete with imports. The increasing openness of Latin American and Caribbean economies will heighten the value of NARS' research in identifying products that can be competitive in international markets. For example, there is growing interest in high-value niche products such as herbs, spices, and specialty fruits, which represent promising opportunities. This is of particular appeal in some arid marginal areas, where the dry climate once offered little in terms of productive potential in terms of domestic markets, but where now there is a potential for national comparative advantage in world trade. Currently, many small and poor farmers lack both the market intelligence to determine which crops can be sold successfully abroad and the technical capacity to move into specialized crops. Furthermore, even larger and more sophisticated farmers hoping to export their products must meet stringent international quality and sanitary standards. Information on export standards and technical support to meet those standards will increasingly become an important part of the NARS extension services.

In addition to export markets, domestic supermarkets are also emerging as an extremely important purchaser of agricultural goods. In fact, local producers' sales of fruits and vegetables to supermarkets were 2.5 times the total world produce exports from the region in 2000.[24] More than any other developing region, supermarkets are increasingly dominating Latin American and Caribbean food retail; by 2000, supermarkets represented 50–60 percent of national food retail sales, having the highest share in Brazil, followed by Argentina, Chile, Costa Rica, Mexico, and Colombia.[25] This transformation of domestic agriculture markets—from smaller, more informal buyers to sophisticated and centralized purchasing by supermarkets—poses a challenge to small local farmers. Supermarkets hold suppliers to high product quality standards and require increasingly sophisticated logistical interfaces. Smaller farmers and processors find it impossible to meet the supermarkets' requirements and are then dropped from their procurement lists.[26] The NARS are not presently oriented to provide farmers with the technological tools and information to serve these specialized purchasers, although their importance will continue to grow over time.

Message regarding agricultural R&D

Evolving markets, future technological demands, and high social rates of return (indicative of major underinvestment) pose institutional challenges for publicly-funded agricultural R&D in Latin America. Policies and financing should be designed to promote flexible organizations and systems that continually learn from their experiences and experimentation and are flexible to rapidly changing circumstances. Beyond the decisions of public agencies, the returns to private investment are determined in part by intellectual property rights protection. The legal framework with respect to these rights in the region should be given more attention as to its design and enforcement. And allowing public research institutions to capture some gains that result from their agricultural R&D

through intellectual property rights would help with regard to budget constraints, but would have to be balanced against the possible distortion of priorities away from efforts with high social benefits, but low private benefits. There is a clear role for publicly-funded research in serving small poorer farmers, particularly in marginal areas. With greater openness of Latin American and Caribbean economies, this role will likely grow, especially in terms of providing market information and the search for products competitive in international markets. The Latin American and Caribbean region is at present an importer of biotechnological innovations and genetically modified plant material, which benefits primarily temperate zones. Given the high fixed costs of biotechnological R&D, tropical crop production would be better served by enhancing incentives for private sector investments, but this requires additional attention to intellectual property rights and safety procedures.

6.3 Identifying socially desirable public policies for rural land markets

Perhaps no other Latin American and Caribbean rural development issue has attracted as much passionate attention as that of land. The region is characterized by inequality in land ownership as compared to other regions in the developing world. A prevailing view in the rural development literature is that, although governments have made considerable efforts over the last three decades, there has been little advance toward reducing deficiencies in land markets in terms of economic and social benefits (Jaramillo 1998). Although the evidence indicates that rural land markets are active with respect to annual average turnover and transactions, markets appear highly segmented by farm sizes, regions, and social classes, with much informality in transactions. Furthermore, many past land reform programs have proved costly, given their limited results, especially with respect to improving social and economic inequalities (see, de Ferranti et al. 2004, pp. 194–8).[27] Land taxes have not generated what were expected to be reductions in land concentration;[28] land titling and registering programs have advanced slowly, as have efforts to modernize the land rental market. These outcomes are not, however, uniform in the region: as de Ferrantic et al. (2004) recognize, land market problems in the Southern Cone are perceived as being less serious than in the rest of Latin America and the Caribbean.

Land policy issues are complex, country-specific, of a long-term nature, and often controversial politically. One complicating factor is that preconceived notions and ideological viewpoints often characterize land policy discussions. Prejudgments undermine good policy design based on the careful analysis of the potential contribution of land policies to broader development, the scope for intervention, and the mechanisms that can be used to achieve broader social and economic goals (Stern in Deiniger 2003). In the context of the nexus between the rural and the national economy, how does rural land policy relate to the contribution of rural areas to national development and national welfare? There are four principal links that appear most relevant to rural land policies and national development and welfare:

1. The issue of land administration policy—specifically the role of secure property rights in stimulating investment and growth.
2. The possible inefficiency in the use of land. The inefficiency argument is connected to the debate on a presumed inverse relation between total factor productivity and farm size, which at one time was the fundamental economic argument used to justify redistributive land reform policies aimed at producing both efficiency and equity gains (de Janvry et al. 2001).
3. The question of poverty alleviation. Access to land has been widely offered as a poverty reduction strategy. The issue of secure property rights enters the poverty reduction debate strongly here, because ownership security allows the poor to use land as collateral, assures of the future flow of returns from investments attached to the land, and aligns private incentives with longer term socially desirable land management. A related issue is the role land redistribution that might play in social cohesion and conflict, especially in areas of highly unequal land distribution.
4. There are also questions of state ownership and land use regulation and zoning associated with land environmental services, a topic that is covered in another section of this report.

Given the great deal of intellectual effort expended on this topic, including recent reports by the World Bank (2003c), Deininger (2003), Tejo (2003), and de Janvry, Sadoulet, and Wolford (2001), one can lay out the areas of general consensus and those that remain controversial. The following paragraphs discuss the first three of the abovementioned links between land policy, rural activities, and development.

Land administration policy—secure property rights for growth

The value of tenure security is one area where there is a consensus. Insecure land tenure is an obstacle to realizing the economic and non-economic benefits associated the incentive to invest in immovable assets and represents a real constraint faced especially by farmers without formal, documented, and enforceable titles. Secure property rights are particularly important for collateralizing both formal and informal loans. Significantly, in most of the Latin American and Caribbean region less than 50 percent of small and medium farmers have legal title to land that they cultivate, either because no title exists or there is no official record (Lopez and Valdes 2000; Tejo 2003).

Insecure property rights also have negative impacts on labor mobility. Rural residents that might otherwise earn higher annual incomes in cities and nonfarm rural work have a greater incentive to stay in rural areas and particularly to continue farming, when they are without secure land ownership. With secure rights, they could rent to others or to sell their land and move to other activities. Without secure rights, there is a risk of losing the land itself and any capital investment associated with it. In Peru, formalization of land rights was found to have increased off-farm labor supply by more than 50 percent.[29]

Although few in number, rigorous studies[30] of the impact of secure property rights on the Latin American and Caribbean region's productivity find that greater security associated with registered titles augments investments attached to land, such as the planting of perennial crops and the installation of drainage and soil conservation measures. Two panel data case studies on Honduras (Lopez 1996) and Paraguay (Carter and Olinto 1996) demonstrate a positive and statistically significant effect of land titling on farm income, attributable to increased land and labor productivity arising from titling's positive impact on investment incentives. The increase in average household income in Honduras was 5 percent (in Paraguay, 0.8 percent), and given titling costs, the return to investment in securing property rights was approximately 17 percent. In both studies farmers chose to expand investments in attached capital more than in unattached capital. For example, in Honduras the effect of more secure property rights was seen in expanded coffee plantations and fixed structures, such as coffee drying patios. In Paraguay, a similar result was found, but only for operations greater than 20 hectares. More recent evidence is now available for Brazil (Alston, Libecap, and Schneider 1996), Nicaragua (Deininger and Chamorro 2002), and República Bolivariana de Venezuela (Delahaye 2001). In Nicaragua, registered titling augmented investments and increased land value by almost 30 percent. In Ecuador, the impact of titling raised property values by 24 percent, and in R.B. de Venezuela, untitled land was about half the value of titled land.

There is, however, much more than formal property registration needed to take advantage of the benefits of secure property rights. There must be an appropriate legal framework on land tenure, available cadastral surveys, a registry of liens to allow its use as collateral and facilitate efficient land transaction, and implementation and enforcement mechanisms, including a functional judicial system. In the Latin American and Caribbean region there are both customary and formal systems, with a large diversity in characteristics. And there are significant areas of land used by indigenous peoples, with relatively well-defined land rights within their communities and where formalized, government-sponsored titling might provide limited benefits. There is little uniformity across countries with respect to property rights and institutional frameworks (in the form of registries, cadastres, and legal systems), and there is heterogeneity even within individual countries. Nevertheless, there is every reason to support a major effort in improving land administration and in enhancing institutional, legal, and administrative processes for transactions involving both sales and rentals.

The 2003 World Bank report, *Comparative Study of Land Administration Systems,* proposed that a land administration system's efficiency and effectiveness should be judged based on an overall assessment of the policy-legal framework supporting it, including an assessment the relative importance and effectiveness of formal and customary tenure systems. (And such assessments should be based on a quantitative set of indicators.) But the report also recognizes that many shortcomings of land administrations systems across countries are not simply the formal rules, but the inability of the civil service and local authorities to implement policy. There is little gain to be had by strengthening a land administration system without also addressing governance weaknesses, a task that in most situations, requires strong political will.

Possible inefficiencies in farm land use

There are some notable cases of extensive livestock operations in some areas of Brazil, Colombia, Ecuador, Guatemala, and Honduras (Jaramillo 1998), which may be socially inefficient due to protectionism, physical insecurity, and

money laundering. More generally, however, the economic efficiency argument for land redistribution has been based on a presumed inverse relation between total factor productivity and farm size, justifying land policies aimed at producing both efficiency and equity gain, as de Janvry et al. (2001) underline. The argument is that larger farms face a disadvantage using hired labor due to problems of moral hazard. Smaller farms use self-motivated family labor, avoiding the supervision cost of farm production. Moreover, transaction costs in labor markets lower the family labor cost relative to hired labor costs.

Nevertheless, Lopez and Valdes (2000) find no evidence of an inverse relation between productivity and farm sizes in a study examining Chile, Colombia, El Salvador, Honduras, and Paraguay. Nor is there evidence that "large is beautiful"—that total farm production (TFP) increases with farm size. And as discussed in chapter 5, estimation of agricultural productivity determinants, both at the micro level and using cross-country aggregate data, show no evidence that land size has a TFP effect. What might explain this result? One observation is that agriculture is becoming more capitalized (especially compared to several decades past), not merely a matter of land and unskilled labor, and is exposed to greater price risks as a result of more open trade and the removal of price interventions. Smaller farm operations could also face disadvantages in financial markets, restricting their ability to incorporate the complementary inputs to land, such as technology and working capital, that would allow them to increase the marginal products of land and labor. In addition, smaller farms often face restrictions in marketing their products as food markets becoming increasingly integrated and emphasize larger volumes and stricter quality controls. De Janvry et al. also attribute the absence of an inverse relationship between size and TFP to government, market, and institutional failures that favor larger farmers. Therefore, if land access might prove an effective poverty reduction strategy, it would require a coordination of efforts promoting both land access for the rural poor and rural development policies that enhance rural competitiveness in input and output markets.

Whether or not government, market, and institutional failures are ultimately the cause of widespread low returns to smaller Latin American and Caribbean farms requires an additional test of the existence and influence of those failures with respect to productivity. Large and medium-size farms may simply be better equipped to accept higher risk and manage open markets and, with an increasing agro-processing concentration that places a premium on volume, standardization, regular supply, and quality. That an inverse relation goes unobserved is not evidence that there are significant failures as an underlying cause, but neither is it a test that those failures do not exist. Moreover, it is not irrelevant that one observes that farm scales in developed and some middle-income countries (where one expects government, market, and institutional failures to be less and the opportunity cost of family labor in terms of nonfarm activities to be increasing) have been growing and continue to grow.[31]

Access to land as a potential poverty reduction strategy

Sometimes overlooked is the question of the potential farming income level that can be generated for the rural household, which is not only a question of technical efficiency in production. This could be the situation of thousands if not millions of small farmers and landless workers, particularly in relatively low productivity areas. In Latin America there is an issue of farm fragmentation, whereby the resulting farms are too small (regardless of how efficient they are) to generate enough income for the family to cross the poverty line. That is, unless the household's income can be supplemented from off-farm income sources.

For some areas off-farm income opportunities exist, as discussed in chapter 2, but off-farm employment opportunities are limited in low-land productivity areas that are remote and sparsely settled (Reardon, Berdegue, and Escobar 2001). As the Taylor, Yunez-Naude, and Ceron (2004) Mexico study finds, total household income is more sensitive to human capital and family member migration than to land or other agricultural assets. Farming intensification through an increase in inputs, both land and purchased inputs (including extension services), while increasing farm production income, could result in less diversification of income sources, reducing off-farm income. Similarly, Lopez and Valdes (2000) find that for small, labor-intensive farms, household income elasticity with respect to land is below 0.15 for Chile, Colombia, and Peru. This is in notable contrast to the farm *output* to land elasticity, which is much higher, fluctuating between 0.36 and 0.46. The difference in elasticities may be due to small farm families redirecting household labor from nonfarm to farm work as farm size grows.[32] From this evidence of a possible tradeoff between farming and nonfarm incomes, one cannot draw the conclusion that increasing productivity (for example,

through better credit markets and extension) is futile for poverty reduction. But the evidence does show that land policies oriented to poverty reduction should be placed in the context of off-farm income opportunities and the role of other policies (such as human capital formation) in enhancing a household's ability to take advantage of diverse income sources. The range of off-farm opportunities will vary by location; sometimes where the range is limited, it would increase the importance of land policies, sometimes where it is abundant, it would increase the importance of schooling and flexible labor markets.

Land reforms more broadly

Today's policy debate over agrarian land reform is much different from that in the 1960s and 1970s. Large-scale land reform is no longer on the policy agenda. Moreover, as Binswanger and Elgin (1990) noted, regardless of its economic merits, the large-scale land reform outlook was bleak because of the high costs of compensating owners for their land's value, given the inability of beneficiaries to pay. Today, it would be difficult to characterize the traditional dichotomy of *minifundio* and *latifundio* as a predominating model as discussed decades ago. In many countries, one observes the development of medium and large commercial farms that are technologically advanced and sensitive to market incentives (Vogelgesang in Tejo 2003). In some countries, particularly Brazil, Colombia, and Guatemala, more modest regional land redistribution programs are being implemented, often related to social conflict in specific areas, without countrywide efficiency and poverty objectives. These market-based reforms have a smaller coverage in terms of the number of farms and will likely not affect significantly the Gini coefficient of land distribution. Market-based compensation for landowners of course implies that massive land reform programs today would be very expensive for governments.[33] The programs in Brazil, Colombia, and Guatemala are small scale.

Certainly what appears to be generally true in Latin America and the Caribbean is the need to strengthen land administration. The limited empirical evidence suggests that there could be high social returns to investing in modernizing rural land administration systems, not only land titling, but more generally in enforcement, information systems, and dispute resolution. And this should not be restricted to land sales and purchases, but also include land rental markets. As shown in Colombia by Deininger, Castagnini, and Gonzalez (2004), rental markets have been much more effective than administrative land reforms in bringing land access to productive and poor producers.

Notes

1. World Bank 2002b.
2. The analysis for "bilateral" trade between the EU as a single entity and other countries is much less clear as to the relative effects of tariffs versus subsidies on import demand. The weaker results might be explained by the treatment of Europe as an aggregate and by the transient trade through Europe of agricultural goods to non-EU countries.
3. See appendix 3.2 in IDB 2002.
4. Welfare gains are estimated to be between zero and 1.2 percent of GDP for countries such as Argentina and Brazil, which are examples of countries that would be expected to benefit the most from global trade liberalization (Bianchi et al. 2004).
5. While recognizing the possibility of endogeneity, the interpretation of the results stresses the causality from international trade to labor outcomes. When prices are used as explanatory variables, this presumption is even stronger, because small countries (such as individual Latin American and Caribbean countries) will have small impacts on equilibrium international prices.
6. Urban hourly wages do not seem to be affected by trade measures, and employment appears to increase with trade (although this effect is sometimes only marginally significant).
7. It should be noted that the Latin American and Caribbean household surveys are not designed to capture the agricultural sector specifically, and that areas identified as rural may be small, semi-urban centers connected to the rural economy, including agriculture.
8. OECD 2002b.
9. Jamaica receives preferential treatment for its sugar exports to the EU and would not benefit (and perhaps lose) from trade liberalization of sugar.
10. See, for example, the study by Krueger, Schiff, and Valdes (1988).
11. The World Bank published the last major comparative study for 1985–95 on the direct effects of agricultural trade policies, covering eight countries (see Valdes 1996). Ideally, it is the relative effective rate of protection between tradables in RNR and in non-RNR activities that would measure policy-induced effects. These are rarely available. See Schiff and Valdes (2002) for a discussion of the various trade and exchange rate policy-induced effects on the RNR incentive.
12. World Bank 2002b.
13. A tariff schedule would only represent a part of total protection. Three additional adjustments would have to be included for a complete picture: tariff preferences, the effects of nontariff barriers (particularly important in the case of sanitary and phytosanitary regulations), and special surcharges (such as price bands in Chile, Colombia, Ecuador, Peru, and República Bolivariana de Venezuela). MFN rates would understate the true protection levels, due both to surcharges and to quantitative restrictions. Estimates of tariff equivalents in the past for Latin America have shown that MFN rates were considerably below the true price wedge between border and domestic prices (Valdes 1996). A tariff equivalent is the ad valorem equivalent of tariff

and nontariff barriers as measured by direct price comparisons between border and domestic farm prices, adjusted for quality differences, transport costs, and other marketing costs. Unfortunately, there are no up-to-date estimates of tariff equivalents that include many countries and a large proportion of the agricultural and forestry sector using a common methodology.

14. See Hoekman, Ng, and Olarreaga (2001).

15. This section is largely excerpted from Acquaye and others (2004).

16. However, some researchers have raised doubts as to the reliability of these estimates, based on the measurement difficulties inherent to returns on R&D (Alston and others 2000).

17. When considering whether or not countries are underinvesting, project selection models suggest that the mode, rather than the mean, is the most relevant measure (Roseboom 2003).

18. In addition, Roseboom (2003) estimates an underinvestment gap for Latin America that is much higher than for developing countries as a whole: 245 percent, compared to the 137 percent aggregate estimate. This region-specific estimate, however, is not statistically robust.

19. Selfing is the pollination of a clone by the same clone.

20. Byerlee and Kelley 2004.

21. Byerlee and Kelley 2004.

22. Nelson 1996.

23. Sulaiman and Sadamate 2000.

24. Reardon and Berdegue 2002.

25. Barret et al. 2003.

26. Barret et al. 2003.

27. Countries that have experimented with agrarian land reforms include Bolivia, Brazil, Chile, El Salvador, Mexico, Nicaragua, Peru, and, of course, Cuba. Colombia has had a smaller program for many years.

28. In almost all Latin American and Caribbean countries, the taxation of agricultural land is not an instrument for raising fiscal revenues, despite it being a proposal on the table for decades. Land and property taxation is relatively underdeveloped in the region, certainly compared to the OECD (de Ferranti et al. 2004). Nor has it been used as a land redistribution instrument. The administrative costs of implementing traditional rural land taxation schemes have been high, although the costs are declining for identifying and appraising farmland productivity and values. Especially in middle-income countries, it would seem that governments now could develop institutional mechanisms to generate relevant information and modern land taxation systems.

29. Cited in Deininger 2003.

30. Some studies note a correlation between land titles and access to credit in Costa Rica, although correlation does not imply causality, because land titling is likely endogenous given the higher incentives to register better quality land.

31. For a discussion of the well-documented case of increasing farm size and scale in the United States, see Gardner (2002).

32. In many Latin American and Caribbean countries, as in richer countries, commercial agriculture is becoming more specialized and increasingly more capital intensive. Thus at the margin, adding a hectare of land, by itself, would have a small impact on farm income.

33. In the 1960s and 1970s, there were massive land reforms, with partial or no compensation for land confiscations. Also, in many countries there was a preference towards cooperative and collective farms as the object of land reform (Peru, Chile, Cuba, and Nicaragua), instead of promoting small farms. In the 1990s and at present, there is no inclination toward collective and cooperative farms and an acceptance of the principle that land transfers should be accompanied by payment according to the land's market value.

CHAPTER 7

Enhancing the Contribution of Rural Economic Activities to National Development: Rural Finance and Infrastructure Services

The previous chapter addressed agricultural sector-specific policies. This chapter turns to domestic policies that are related to all rural economic activities and to rural household welfare more generally.

7.1 What role should the government play in rural finance and development?

Governments throughout the world intervene in rural credit markets. Interventions range from attempts to improve the enabling environment for the development of private credit markets through regulatory reforms and interest rate subsidies by public banks to farmers. Traditionally, subsidized agriculture credit programs—an approach adopted by many Latin American and Caribbean countries—were justified based on the argument that such programs enhanced rural development. Evaluations of these programs, however, have shown that they are usually limited in outreach, and have low recovery rates, high costs, and little identifiable farm level impact. In numerous countries, from Peru to Malawi to Indonesia, government-sponsored rural credit programs have faltered under the weight of losses generated by traditional directed credit subsidies.

The research presented in chapter 5 suggested that only in some countries has formal credit availability (primarily through banks) been associated with improvements in agricultural productivity, but in chapter 3, there was strong evidence suggesting that financial market development plays a role in mitigating the rural sector's contribution to macroeconomic volatility by promoting income diversification. With greater access to credit, farmers might increase their specialization in production, but rural households could diversify into nonfarm activities. Furthermore, there is also strong empirical evidence suggesting that important segments of the Latin American and Caribbean rural population have unsatisfied demand for credit. This seems to be the case in both Brazil and Mexico, for example, where recent econometric analyses show that geographic locations affect individuals' abilities to gain access to credit, despite personal, familial, and professional characteristics (Sánchez et al. 2003; World Bank 2004a). Thus there are still good reasons to think about the public sector's proper role in financial services in Latin American and Caribbean countries.

There is growing recognition that government interventions in rural financial markets should aim at facilitating the working of the market so that private participants can allocate resources in response to incentives. Government interventions can play a constructive role by tackling directly the failures of financial markets and using an appropriate mix of instruments. The design of market-oriented interventions aims to complement, facilitate, or improve rural financial markets over the long term, enhancing competition and cost effectiveness. It is, however, unlikely to be politically feasible to eliminate rural credit subsidies immediately, especially those for small farmers, and to turn government attention solely towards improving the enabling environment for private initiatives. Today there is a search for a middle ground, and this section focuses on some key issues related to this middle-of-the-road approach to rural financial development.

BOX 7.1

What market failures are relevant to rural finance?

In rural finance, market failures are associated with the following:

(1) *High transactions costs* may prevail, thus there may be financing demand but not sufficient supply due to high minimum fixed operational costs for the financial services provider. Essentially, demand is too small relative to fixed costs usually because the area is characterized by poverty, low population density, crop failures, lack of traditional collateral, and limited opportunities for diversifying risks.

(2) *Free-riding:* Externalities may arise because investors cannot gain the full benefits of their investments if they cannot *exclude* others from free-riding. Specifically, rural areas are generally characterized by low-income families that are underexposed to modern financial instruments such as credit and insurance. Therefore, public education costs may be quite significant to familiarize potential buyers with—and to muster confidence in—these instruments and thereby alter behavior. Once this obstacle is surpassed, however, numerous competitors are likely to enter the market, and a market that is initially profitable may turn out to be not as lucrative.

(3) *Asymmetric information:* According to Stiglitz (1996), the critical factor that explains the externalities, missing markets, and local monopolies in rural financial markets is imperfect information. Financial transactions involve a contractual exchange of cash for a promise of a future stream of payments, rather than a simultaneous exchange of cash or goods, or both, for goods. This promissory feature of financial transactions makes complete information about a counterpart's ability and willingness to pay an essential requirement. However, asymmetric information constrains the lender's (or depositor's) ability not only to discern the creditworthiness of potential borrowers (or banks), but also to enforce contracts. Thus, asymmetric information makes it incumbent on governments to regulate financial intermediaries, for instance, to limit excessive risk-taking by banks using other people's money, and to provide a sound legal and regulatory framework for enforcing contracts.

As a case in point, rural areas are sometimes characterized by obsolete methods of determining land ownership that, at best, are not captured by the formal titling system and, at worst, lead to severe conflict. Though untenable, this situation is very expensive and institutionally difficult to correct. This situation makes it difficult for financial institutions to provide financing for investors that have no traditional form of collateral. It is this market failure that government intermediation may seek to address.

(4) *Failure to provide insurance:* There is significant ambiguity in the discipline as to whether missing insurance markets can be correctly classified as a market failure. In its classic interpretation, the failure to provide insurance may be attributable to high transaction costs or even asymmetric information. However, a major cause of the failure is a lack of large markets, the lack of crop diversity that prevents risk transference, and the scarcity of actuarial information. Therefore, because of the missing markets (not necessarily a failure, but missing nonetheless), market participants may not be able to ensure against certain contingencies.

Source: Besley 1994.

This cautious approach accepts public interventions that directly deal with existing rural finance market failures that affect the extent and quality of the provision of various services, including services that facilitate payments, savings instruments, credit availability, and the development of rural insurance products. The discussion below concentrates on the last two issues, but this does not mean that payments and savings instruments are unimportant for rural households.

Programs that can address rural finance deficiencies

The search for new modalities of public intervention in rural finance is at an experimental stage, and little is known about how various types of interventions work.[1] Nevertheless, it is well known that rural finance faces special difficulties (see box 7.1) and therefore may merit special solutions. First there are geographic issues of access in remote rural areas. These are combined with typically high poverty rates, lower

BOX 7.2

Governance criteria for public rural financial services

- Fully autonomous management that is held accountable for the bank's financial performance.
- Exemption from civil service pay scales to attract and reward quality staff on the basis of the institution's financial performance.
- Insulation from staffing pressures by local authorities, for example, through autonomous organizational charts with professional qualifications criteria.
- The same freedom to set borrowing and lending rates that apply to commercial banks, so that both deposit and lending rates are at market rates, are usually positive in real terms, and provide an adequate spread to cover costs.
- Application of international best practice prudential regulatory, accounting, and disclosure practices, and therefore the development of a strong management information system by the rural financial institutions, and both offsite supervision and onsite examinations by the same agency that supervises private banks.
- A hard budget constraint.

Source: Yaron, Benjamin, and Charitonenko 1998.

population densities, isolated markets, sharp seasonal variations in income and in the demand for and supply of financial resources, and a lack of traditional collateral. All these factors result in high transaction costs and higher perceived risk in providing financial services in rural areas.[2]

Although there may a consensus with respect to the basic problems underlying rural financial markets and the general nature of desirable outcomes, there remains disagreement as to the manner and degree of direct government intervention. Direct interventions would be warranted if they address the problem's cause in a cost-effective manner, and, of course, if the net results are a positive benefit, all of which introduces the monitoring and evaluation problem (see the discussion, below). Based on experience, some effective government intervention approaches are outlined below. While not a panacea, these strategies represent an attempt to address the market failures associated with rural finance systematically, and their success depends on specific local conditions.

The enabling environment: Reducing high transactions costs

Public support for rural financial markets does not imply that the government is necessarily the direct credit provider because targeted subsidies and other types of support can be used to accelerate the development of institutions. High transactions costs are usually addressed through government regulations promoting the development of microfinance institutions with a focus on poverty, by mainstreaming financial institutions that provide small-scale finance, or by promoting cost-reducing technologies and alternative ways of reaching targeted markets. Good governance is a common thread in the success of microfinance institutions. All roles and responsibilities should be clearly defined and consistently enforced, with limited bureaucratic restrictions of management and accountability.

The type of supervision and authorizing environment may vary based on the institution's size and mission, but the government provision of financial services in rural areas is not recommended unless it meets strict governance criteria (see box 7.2). These criteria are applicable not only to mainstream finance through commercial banks, but also to microfinance institutions (MFIs),[3] which might be relevant for small rural producers and rural poverty. Honohan (2004) investigated the national characteristics that enhance more effective microfinance penetration by conducting a regression analysis of cross-country variation in penetration ratios using worldwide data. The results were consistent with the view that, in addition to potential market size, good institutions promote growth in the microfinance industry. In other words, the same institutions that help develop formal credit markets also affect microcredit development.

The Honohan results also suggested that *excess* profitability of mainstream financing could discourage microfinancing efforts, because of the higher opportunity cost to experts in strategic management working in a marginally profitable microfinance industry relative to utilizing their talents in a robust and stable mainstream commercial sector. Hence, another policy implication for government intervention is a regulatory environment that encourages entry into microfinance (for example, by targeted antipoverty microfinance support), combined with the removal of protection from competition of the mainstream domestic financial sector. If

formal domestic banks are protected from foreign competition, for example, this will also discourage the deepening of microcredit markets, because they compete for the same talent pool of managers and entrepreneurs.

Addressing asymmetric information and poor credit culture

Financial transactions involve a contractual cash exchange for a promise of a future payments stream, rather than a simultaneous exchange of valuables. This promissory feature makes it essential for participants to be well informed about their counterpart's ability and willingness to honor contractual obligations. Rural areas are generally burdened with poor credit cultures and lack of any indication as to ability to pay. Even if it is locally recognized through local custom that an individual is sufficiently able to adhere to loan conditions, there is no way of this being captured in the formal finance system. The policy objective is to reduce credit information asymmetries so that individuals may have access to adequate financing. Significant effort is required to simplify the legal framework to make the enforcement of contracts more effective. Possible interventions at the initial stages include the following:

- Developing credit information database/centers and client credit histories at the parochial or national levels in a cost-efficient manner could encourage more financial institutions into rural finance. Private interests could eventually maintain such centers.
- Establishing a mechanism for legal recognition of more types of nontraditional forms of collateral, such as movable property.
- Implementating a simple and cost-effective program to promote proper land titling and other property rights issues.

In some situations, working on the improvement of the environment for private rural financial activities may not be sufficient in the short term. Some demand- and supply-side interventions may be warranted, although they could be designed without directly subsidizing interest rates. On the supply side, to correct a lack of credit produced by asymmetric information, partial credit guarantees might be offered to private banks or financial institutions that lend to rural entrepreneurs and families. On the demand side, matching grants for farmers with investment projects are also possible, thus addressing the market failures caused by a lack of credit culture in rural communities.

Dealing with coordination failures

In addition to, there is an emerging consensus that the promotion of new technologies can be used to penetrate previously untapped rural markets, as evidenced by the World Bank-supported Banco del Ahorro Nacional y Servicios Financieros (BANSEFI) project in Mexico. BANSEFI, a government-created development bank that will be providing services to over 700 MFIs, aims to reduce costs to microfinancing efforts by allowing the sharing of functions, accounting and reporting services, and information technology. In other words, BANSEFI will play the role of a logistics service provider for a large community of MFIs. By establishing a technological platform, BANSEFI can, among other things, offer window services, accounting services, and "back office services," and generate regulatory reports for savings and popular credit institutions. Although this type of program is yet unknown, it is probably worth experimenting with this model, where a publicly-supported organization helps numerous smaller providers of financial services at the regional level to overcome high fixed costs of operating under a sound regulatory regime.

Public intervention should seek to promote both mainstream finance on the one hand, and MFIs and other nonbank intermediaries on the other (such as input suppliers and contracts with buyers), because they complement each other. Experience shows that the total microfinance assets and loans are very small relative to mainstream finance, even in countries where microfinance has flourished.[4] In effect, it does not compete with conventional finance for such funds.[5]

The successful provision of MFI services may require challenging cultural values and expectations developed over many generations, which is likely to be a difficult and expensive proposition. The longer-term payoffs to private or small-scale community efforts may not justify the public education investment because competitors might enter the system after the initial barrier was significantly reduced. To encourage microfinance investments, government policy could explore direct subsidies toward public education programs in target areas in an effort to lower barriers to entry.

Addressing missing insurance markets

The principle of insurance provision is based on the pooling of the individual risks of large numbers of persons and enterprises. In rural financial markets, however, where agri-

BOX 7.3

Risk management approaches of farmers and other rural producers

Rural producers and communities employ several mechanisms to deal with the risky business of farming, and any interventions must account for the likely effect on these mechanisms and the resources available to farmers. These mechanisms include:

Information gathering:

- *Using and improving information available* in decision making, for example, market prices, regional rainfall probabilities, new crop varieties, emerging markets, and so forth.

Risk avoidance:

- *Adopting a precautionary stance,* with the costs balanced against the possible reduction in serious negative consequences.
- *Using less risky technologies* of lower but reliably yielding drought-resistant crops or production of crops with more stable markets over those with potentially higher but less certain returns.

Diversification:

- *Diversifying production systems* by planting a variety of crops for separate markets to mitigate climatic, disease, pest, and market vulnerability.
- *Acting with flexibility* to adjust to changed circumstances, reflecting physical assets and markets.
- *Financing farm activities* with credit and borrowing in cash or in-kind, based on social capital.

Risk Sharing:

- *Using informal and formal insurance* by making small investments expected to provide returns only in the event of difficulty or catastrophe, for example, cash or gifts, "banking" through social capital.
- *Using risk pooling* in formal or informal arrangements to share outputs and production costs.
- *Using contract marketing and futures trading mechanisms* (such as forward contracting to sell all of a crop at an agreed price, futures contracts, and hedging) to reduce price risks for commodities not yet produced or for future inputs.

In addition to the above treatments, Skees, Varangis, Larson, and Siegel at the World Bank have conducted significant research on many of the risk-coping strategies outlined above. Their research focused on private and public mechanisms for managing such covariate risks for natural disasters. They used innovation in Mexico to demonstrate that markets may more easily provide rainfall insurance than traditional crop insurance in many developing countries. In addition, they use parametric insurance to cover covariate risk for a community of poor households through formal and informal risk-sharing arrangements among households that are purchasing these index contracts. They have also suggested that the basic infrastructure and contracts that are needed to index and insure catastrophic weather events could also be used to support emergency disaster in developing countries.

Beyond the interesting aspects of small farm agriculture, Mexico has two major innovations that have direct bearing on the issue of insurance: (1) the Fondos, which are mutual insurance funds whose members are commercially-oriented small farmers; and (2) FONDEN, a federal program that provides ad hoc funds for natural disasters. Both of these institutional arrangements provide opportunities to share covariate natural disaster risk.

Source: Anderson and Lucas 2004.

culture is usually the mainstay of economic activity, the high risk, sparse interest in, and unfamiliarity with the prudence of formal insurance deters the development of a demand sufficient to allow the profitable pooling of risk for potential entrants into the market. Although farmers and rural communities employ several mechanisms to deal with the risk (see box 7.3), public intervention can facilitate better risk management through improved information and credit history systems, the development of financial markets, the promotion of market-based price and yield insurance schemes, and the assurance that the poor are able to benefit from these policies. Two arguments for initial government support to crop insurance are related to (1) information requirements and (2) overcoming the unfamiliarity of farmers with formal insurance. With respect to information, there are start-up costs associated with actuarial calculations of the probability of premium income and payouts, and such investments yield externalities beyond a single

insurance company. With respect to the unfamiliarity of farmers, there is an infant-industry argument for transitory subsidies to reduce private costs and stimulate a demand for insurance. But neither argument implies permanent subsidies.

There are two common approaches to alleviate the effects of natural disaster risks: (1) traditional crop insurance that gives individuals the opportunity to protect against natural disaster risk ex ante; and (2) disaster aid that gives assistance ex post. There are important differences between these strategies that involve access, incentives, and costs to society. One potentially negative effect of free disaster aid is the reduction in incentives for individuals to purchase crop insurance.

Government-supported crop insurance has been long promoted as an important contribution to the management of rural household risk. A market-based, risk-sharing insurance alternative for agriculture does have many potential advantages (see box 7.3). Reducing the risks associated with commodity production could also help raise access to credit for potentially profitable rural investment projects in the long run. Crop insurance can be used as collateral for small and medium-size farmers who would otherwise be unable to obtain credit, which plays an important technological development role in some countries, as discussed in chapter 5. The provision of individual crop insurance involves monitoring and some form of farm-level inspection when crop losses are claimed; aimed at small plots that the rural poor farm, such efforts are cost prohibitive for private firms. This market failure caused by the high fixed costs incurred by insurance providers probably explains why there are no examples of successful crop insurance programs without heavy reliance on government subsidies (Skees, Hazell, and Miranda 1999; Skees and Barnett 1999).

Nevertheless, traditional crop insurance and the eligibility to benefit from government support are directly tied to production decisions. Even if crop insurance provision carried low government costs, it would be of limited value to the rural poor, for whom growing crops generally represents a small proportion of the household portfolio. In Mexico, for example, only around 20 percent of poor, rural farm household incomes come from their own farm activities in crops and livestock. Paying crop insurance premiums is even more problematic for the rural poor. More fundamentally, adverse selection and moral hazard are serious problems in providing traditional crop insurance, adding to its costs. High deductibles or co-payments are one way to reduce these problems, but these solutions reduce the portion of actual crop value that can be effectively insured.

One alternative to the problems of high monitoring and inspection costs and moral hazard and adverse selection, is the adoption of area-yield or weather-indexed insurance schemes (see box 7.4). Properly-designed weather-based index contracts could be used in a variety of ways within a developing country as a means of supplying a form of direct insurance for anyone at risk when there are major droughts, freezes, or floods; facilitating mutual insurance and collective action; providing a form of reinsurance for the private or government agricultural insurance company; and, giving clearly defined disaster aid in a standing disaster relief program for the rural poor, as with the Mexican Fund for Natural Disasters (FONDEN).

Beyond the farm-level problems, there are regional risks associated with insuring crop yields, and the development of a market for such insurance depends on the use of international reinsurers to cover the risks of those firms or agencies making the original insurance commitments. Insurance for catastrophic natural disaster risk is in particularly low supply and can become cost prohibitive for the poor for a variety of reasons (Skees and Barnett 1999). Especially in developing countries, the risks associated with a widespread natural disaster can neither be balanced by pooling across many insurance buyers, nor sustained by the financial wherewithal to balance large present outlays with long-term income from premiums. Consequently, primary insurers rely heavily on traditional reinsurance markets, but this may be prohibitively expensive or impossible in many cases as most reinsurers shy away from underwriting agricultural risk in developing countries. The costs related to reinsurance eventually are reflected in the farm-level premiums paid; and even when farmers might afford the insurance from a purely objective actuarial assessment, there is a cognitive problem in assessing catastrophic risk (Kunreuther and Slovic 1978; Kunreuther 1996), provoking an underestimation of the real risk and a perception that the price is too high.

Problems with free disaster assistance

When traditional crop insurance is either inappropriate or unaffordable for poor farmers in managing income risks related to natural disasters, governments have access to other measures. Free disaster assistance is a common response, even among poor countries, and especially so

BOX 7.4

Weather indices and area yield for crop insurance programs

There is an emerging literature about how rainfall insurance could replace traditional crop insurance (Gautum et al. 1994; Sakurai and Reardon 1997; Skees, Hazell, and Miranda 1999; Skees 2000). A key advantage of this kind of insurance is that the weather or "trigger" event (for example, a rainfall shortage) can be independently verified, and is therefore not subject to the same possibilities of manipulation that are present when insurance payments are linked to actual farm losses. And since the contracts and indemnity payments are the same for all buyers per unit of insurance, the usual problems of moral hazard and adverse selection associated with public crop insurance are lessened. In addition, the insurance would be easy to administer, since there are no individual contracts to write, no on-farm inspections, and no individual loss assessments. This can help make the insurance affordable to a broad range of people, including agricultural traders, shopkeepers, and landless workers whose incomes are also affected by the insured events.

Weather index insurance would also be easy to market. For example, it could be sold through banks, farm cooperatives, input suppliers, and microfinance organizations, as well as sold directly to farmers. Weather insurance is not only for producers and rural people. Banks and rural finance institutions could purchase such insurance to protect their portfolios against defaults caused by severe weather events. Similarly, input suppliers could be the purchasers of such insurance. Once financial institutions can offset the risk with this type of index insurance, they would be in a better position to expand credit to farmers, at perhaps improved terms.

There are few applications of weather-based index insurance in agriculture. An insurance plan in Canada in the province of Ontario uses rainfall indexes and another one in Alberta for corn uses temperature-heat units. Also, a private insurance company in Argentina is offering a rainfall insurance contract to a milk-producing cooperative (there is strong positive correlation between rainfall and milk yields). While the overall number of applications is still relatively small, interest is growing. There are several applications of index insurance in agriculture based not on rainfall (or temperature), but on average area yields. Instead of rainfall, the index that triggers the insurance payments is based on estimates of the average yield for a county or other predetermined area. Area-based yield insurance has benefits similar to weather-based index insurance as long as there is a reliable assessment of area yields. Some of the countries that have developed agricultural insurance products based on area yields are Argentina, Brazil, Canada, Sweden, the United States, and Morocco; the latter is still on a pilot basis.

The International Finance Corporation (IFC) of the World Bank Group is working toward assisting developing countries to get access to the newly developed weather markets. In this role, the IFC plans to take a financial interest in these markets, increasing the likelihood of their success. A specially funded project was also awarded to a working group in the World Bank. This project has investigated the feasibility of developing weather-based index contracts for four countries: Ethiopia, Morocco, Nicaragua, and Tunisia. Since the project began, several of the professionals involved have begun similar investigations in other countries, including Argentina, India, Mexico, Mongolia, and Turkey. There is clearly a growing international interest in weather insurance.

Source: Skees et al. 2002.

when the international community quickly responds in the event of natural disasters. International aid, however, is more likely in the face of major hurricanes and earthquakes, but not as forthcoming when the natural disaster is a slowly developing drought. And disaster aid is almost always after the fact, with few rules and no real household-level knowledge with respect to how much support might come and who will get the aid. This also raises serious equity questions and opens the door for corruption and abuse.

In many developing countries, disaster aid comes in the form of debt forgiveness, which typically does not help the poorest rural residents, who tend not to have credit. For that matter, few countries actually have disaster aid programs that are targeted at the poor. (Mexico is an exception—see box 7.3.) Furthermore, economists have been rightly concerned

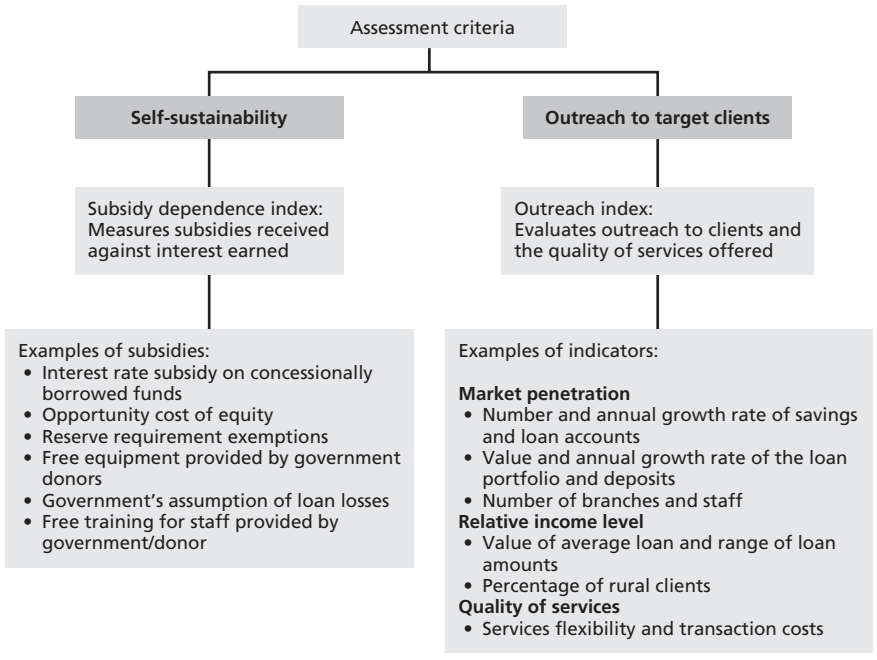
with the incentives embedded in free disaster aid (Dacy and Kunreuther 1969; Kunreuther 1973, 1993, 1996; Anderson 1976; Rettger and Boisvert 1979; General Accounting Office [GAO] 1980, 1989; Freeman and Kunreuther 1997). When households grow to expect government compensation for natural disaster losses, they take on additional risks. Disaster relief tends to become self-perpetuating when individuals do not receive proper price signals about their exposure to losses from natural disasters. To avoid some of the problems with too much free disaster aid, risk must be internalized or at least made explicit. For example, in insurance and other risk-sharing markets, risk should be priced so that decision makers perceive the real costs of the risk that they might transfer to others. Even when free disaster aid is provided, it would be more efficient to make the rules for such aid explicit and to provide it in such a fashion that the expected value of the aid is similar across different regions.[6]

Monitoring and evaluation of government interventions in rural financial institutions

There is professional uncertainty as to the most efficient policy interventions for governments to employ to reduce poverty and expand income levels. It is very difficult to evaluate the effect of rural credit programs on incomes and poverty because it is very difficult to ascertain what borrowers' next best alternative would have been in the program's absence. Practitioners and academics have developed a framework for assessing the performance of these credit programs. This framework is based on outreach and self-sustainability (Yaron 1992a). It is supported by the argument that rural financial institutions that provide a broad range of services to the targeted clientele in an efficient manner are likely to have the desired impact of expanding incomes and reducing poverty. Therefore, evaluating their performance based on these criteria provides an easily quantifiable proxy of the impact of rural financial intermediation in lieu of a full benefit-cost analysis (see figure 7.1).

Outreach is measured by a hybrid index comprising several indicators, such as the number of clients, the loan portfolio's value and annual growth, the percentage of female clients (where social norms discriminate against women), the average loan size (as proxy for income level of the clientele), and so on. By calculating the subsidy dependence index (SDI), self-sustainability is assessed, that is, the percentage

FIGURE 7.1
Assessing the performance of rural financial institutions



Source: Yaron, Benjamin, and Piprek 1997.

by which the agency's average on-lending interest rate would have to increase to make it self-sustainable (Yaron 1992b; Benjamin 1994). Conventional accounting practices fail to reflect most subsidies that state-owned rural financial institutions or NGOs receive and therefore do not show the true social costs of maintaining these intermediaries. However, without this measure it is not possible to establish the virtue of continuing support for these institutions. Given the widespread use and high costs of subsidies, the SDI determination is essential to evaluating MFI performance. Another tool used in assessing the performance of MFIs is the net present value of costs (NPC_s). The NPC_s is more useful for longer-term (more than one year) calculations, whereas the SDI is more accurate in short-term calculations.

Risk and the rationale for intervention

Risk in agriculture is pervasive. These risks include climactic, environmental, social and economic, and political risks. Several World Bank risk and vulnerability assessments have shown that commodity price, yield (mainly weather-related), and health risks are the most important risks that rural households face. Households are vulnerable to those risks when a significant loss threatens the sustainability of their livelihood base, a common situation for many small-farm households in developing and transition economies. Profit is the reward for risk taking, and therefore, any profit-seekers in the farming business, as in any other business, must be able to bear some risk. Many farmers, however, are highly vulnerable and cannot readily bear additional risk in their farm/herd management or its potential shocks to their households. Just what farmers do to moderate the effects of risk is remarkably similar at all economic levels and throughout the world (see box 7.3). The specific components of these mechanisms vary as does the degree and formality with which farmers employ them. The more informal mechanisms for risk coping may reduce the income of farmers (for example, diversification may come at the cost of specialization and higher incomes). Any government intervention targeting risk must take into account how farmer risk management mechanisms are applied, as well as farmers' resource base.

In most Latin American and Caribbean countries, the government-supported rural financial institutions, which formerly subsidized credit, have been undergoing a reform process. In attempting to obtain the public good of rural finance interventions, one of the most difficult questions in selecting appropriate interventions is to be realistic about meeting strict governance criteria. In general, governments should avoid involving themselves in sophisticated mechanisms beyond their agencies' supervision and enforcement abilities. The role of government support to the financial system with respect to medium-size and large farmers should be restricted to the design of new instruments and administration of the regulatory framework. But it is questionable whether subsidized credit should be offered to well-to-do producers. By contrast, the situation of small farmers is different: liquidity problems, asymmetric information, and high transactions costs relative to the small production volume at the individual farm level could merit transitional subsidies through credit guarantees, matching grants, longer repayment terms, and subsidized extension.

Finally, one should not forget what is regarded as of growing importance in several countries in the region: nonbank credit tied to input supply and product sales. Although not well documented, it appears that a growing proportion of the credit demand is being met via intermediaries that act to coordinate formal financial institutions with farmers. This is a potentially important innovation generated by private initiative and needs further analysis to provide a better context for considering government interventions.

7.2 Infrastructure investments for regional development and the poor

From the perspective of the national economy, the adequate supply of services generated by infrastructure investments has long been considered of key importance in ensuring economic productivity and growth (World Bank 1994). Various cross-country econometric studies have substantiated the importance of infrastructure provision to national output[7] and have shown that in particular, government expenditures on transportation and communications capital increase growth rates.[8] For Latin America, Calderón and Servén (2003) find significant positive contributions to national output of telecommunications, transport, and power generation; indeed, the estimated marginal productivity of these types of infrastructure capital is greater than that of noninfrastructure assets. Infrastructure has been linked to the alleviation of income inequality[9] and the ability of countries to take advantage of trade liberalization[10] by allowing the growth of exports and the efficient allocation of resources in the economy. And as seen in earlier chapters, infrastructure has impacts on the agricultural sector's productivity, depending on country characteristics and the type of infrastructure. Consequently, infrastructure assessment and investment are important issues on national policy agendas in most developing countries.

Infrastructure and the poor: Existing evidence on multiple effects

What effects does infrastructure have on the poor communities and households that remain in rural areas?[11] The value of the assets of poor farm households are, in part, determined by distance to markets for agricultural goods, and improving road and communications infrastructure are a means of effectively reducing that economic distance and thereby benefiting poor landowners.[12] Various studies have concluded that for many developing countries, rural infrastructure investments contribute to agricultural production and productivity growth that is faster than population growth.[13] This more rapid productivity growth leads indirectly to higher incomes for poor rural households.[14] Lower transportation costs reduce input and marketing costs and free farmers to shift resources to productive inputs, such as fertilizers (Zhang and Fan 2004). The output mix choice is also conditioned by access to infrastructure, especially in the case of transportation; with more reliable and rapid transportation and the consequent reduction in costs associated with the marketing of perishables, farmers shift land use decisions from lower-valued cereal production to higher-valued fruit and vegetables.

But greater access to markets also increases returns to labor. A recent World Bank report (2003) credits the reduced time to reach markets due to the expansion of infrastructure services for generating large gains to the poor in El Salvador. In addition, improved roads increased incomes and wage employment in Peru. Estache and Fay (1995) report, for Argentina and Brazil, that increasing road and sanitation access has promoted income convergence for the poorest regions. With regard to roads in Vietnam, analysis of the evidence (Deolalikar 2001) similarly concludes that road investments in poorer provinces has positive effects on agricultural productivity and the growth of per capita industrial output.

Other analyses have found important links between infrastructure services and the reduction in poverty in rural areas. Studies for India and China[15] show that infrastructure development was a key determinant of the progress made in reducing rural poverty. The most effective incremental poverty reduction expenditure is found to have been on road investments in India. For Western China, the most effective incremental expenditures were on agricultural R&D, education, roads, and electricity. For both India and China, an important source of this poverty reduction was the growth of rural nonfarm employment, which depends on the availability of infrastructure services. The Ravallion and Datt (1999) study showed poverty reduction's importance on the growth in nonfarm economic activities, conditioned on literacy, infrastructure availability, and initial poverty levels.

Better infrastructure services also have human capital development implications both in terms of education and health. Improving local transportation and creating safer road networks improves school attendance, and with increases in the electrification of rural areas comes more time for study. Both improved education and better health care improve employment opportunities and income levels. The Deolalikar (2001) Vietnam analysis shows that in poor provinces, road infrastructure increases the use of public health facilities and raises secondary school enrollments in the poorer provinces.

Water and sanitation improvements are especially important in child mortality and educational attainment. Leipziger and others (2003) find that increasing access to water and sanitation can significantly reduce child, infant, and maternal mortality. Using cross-country analysis, they conclude that differences in service coverage of infrastructure variables explain a substantial portion of the difference in health outcomes between rich and poor. Their water access index explains about 25 percent of the difference in infant mortality rates and 37 percent of the child mortality rates, when comparing the poorest quintile with the richest. This finding is supported by several studies that use subnational data.[16] Galiani and others (2002) report that for Argentina, increasing water and sanitation access reduced child mortality by 8 percent, and the largest contribution to this decline was in places with the greatest expansion of water infrastructure, namely in low-income areas.

In terms of the welfare of poor households, several studies have noted the complementarities of infrastructure services, education, and rural nonfarm employment (Reardon et al. 2000; Leipziger et al. 2003). For example, road access in rural areas reduces the household time required for many nonfarm activities, as illustrated by the case of women living near roads in rural Cameroon who earn more than double the income of women living in isolated areas from food production and sale. In a study on the effects of having access to electricity, water, sanitation, and telephones in Peru, Chong and Hentschel (1999) show that households receiving all services showed a significantly higher rate of consumption growth (37 percent) when compared with households receiving no services. Households that receive

just two services show a 10 percent faster consumption growth. (For rural areas, electricity access was found to have the largest effect on household consumption growth, in contrast to urban areas, where access to telephone services was most important.)

The importance of the potential complementarities of infrastructure services is reinforced in a recent World Bank-commissioned study by Escobal and Torero (2004) for Peru, which finds that the availability of rural water, electricity, telephone, and road infrastructure enhances the opportunities for rural households to generate income and lowers their chances of being poor. A rural household's hours of work per week rises significantly with access to at least two infrastructure services, as does the diversification of income sources. Those households with no access to infrastructure services spent, on average, 85 percent of their working time in agriculture, compared with the 55 percent of working time spent in agriculture by households with access to three or four services.

Unfortunately, 74 percent of rural households in Peru have access to only one or none of the four infrastructure services, and only 5 percent have access to all four. There is substantial evidence that cooperative interactions between services can have compounding effects on family income: estimates show that the combined effect of access to water and telephone services, for example, is a 38 percent increase in rural household income, compared with the sum of individual effects on increased income of 11 percent. Escobal and Torero also estimate that making all infrastructure services available to the 30 percent currently without access to any service could contribute to moving a half a million Peruvians out of poverty.

It should be kept in mind, however, that simply spending money on infrastructure investments is not enough to ensure that the above-discussed benefits reach poor households and regions. The quality of infrastructure services (and the manner in which the investments are financed) determines the eventual effects of investments on economic growth in general and household welfare in particular. Aschauer (1989) shows that a performance index (combining efficiency and quality indicators) is both highly significant in explaining growth and important in determining the estimated influence of other explanatory variables in a cross-country growth model. Evidence from the Collier and Gunning (1999) study of African country growth underlines the importance of the poor quality of services in hampering the ability of infrastructure investments to contribute both to productivity in economic activities and to development. Aschauer (1989) takes the case of Mexico to show that, in comparing elasticities, an increase in the *efficiency* of infrastructure services (holding the stock constant) would contribute approximately the same to economic growth as an increase in the *stock* of infrastructure (holding its efficiency constant).

Infrastructure, especially related to reducing transportation costs, is important for both domestic commerce and taking advantage of trade. Booth, Hanmer, and Lovell (2000), for instance, cite the case of Uganda, where a survey of manufacturers showed that they ranked the primary limitations to doing business as power outages and voltage fluctuations, telecommunications, and road infrastructure. Despite trade liberalization in that country, transport costs represent effective protection that equals almost 50 percent of the production value added for the domestic market (Milner, Morrissy, and Rudaheranwa 2000). Examining a variety of developing countries, Limão and Venables (2000) also show that there is a very high elasticity of international trade with respect to transportation costs.

The impact of transport infrastructure on trade flows between Sub-Saharan African countries is particularly notable: approximately 50 percent of the transport cost premium for such trade (which is double that of other developing regions) can be attributed to poor infrastructure development reflected by road, rail, and telephone density. (For landlocked countries, transportation costs associated with international trade are higher still.) As pointed out by Wood and Mayer (2001), the improvement of poor infrastructure services in general and transport in particular, would not only enhance the prospects for the export of manufactures, but would allow the region to take advantage of primary product trade.

Relative to industrial countries, logistics costs in Latin America and the Caribbean countries are significantly higher, a fact that is for the most part explained by individual country's income levels and population and geographic sizes. As was addressed in detail in a recent World Bank study,[17] improvements in infrastructure quality have the potential to reduce logistics costs associated with higher freight rate markups, long waiting periods to clear goods from ports, and larger inventories of raw materials. It is worth emphasizing that estimates of the impacts of lower transport costs for Argentina, Brazil, and Mexico show that the main beneficiaries in terms of value added are agriculture, natural resource–intensive, and labor-intensive sectors.

Increases in the amount and quality of infrastructure investments in the Latin American and Caribbean region have been linked to infrastructure policy reforms. Such reforms have been more substantial in the Latin American and Caribbean region than in other developing regions and have included privatization, the breakup of vertical integration, enhanced competition, and less-politicized regulatory frameworks. Fay (2001) reports a surge in the reform-oriented 1990s of private financing for infrastructure in the region, although such private investments have disproportionately favored telecommunications and transport, which suggests a continued important public financing role in energy, and water and sanitation.[18]

For developing countries generally, the World Bank (2002a) also emphasizes private investments that have been made in infrastructure projects as one indication of the success of reforms over the last two decades. During the 1990s, foreign private capital going to infrastructure amounted to $550 billion, compared with $150 billion in aid directed to infrastructure. Most of these private investments were for telecommunications (45 percent) and energy (32 percent), but significant amounts were directed to transport (18 percent), and water supply and sanitation (5 percent). But these investments were directed primarily to upper-middle income countries, notably Argentina, Brazil, Hungary, Malaysia, Mexico, and South Korea, which together received nearly 80 percent of the foreign private investments during the 1990s.

Estache, Foster, and Wodon (2001) survey the consequences of some specific cases of Latin America and the Caribbean infrastructure reform. Within five years of Peru's sale of more than one-third of its national telephone companies, fixed lines increased 165 percent and cellular phones rose to more than a half million (from a base of about 20,000). Low-income households in particular were beneficiaries, with dramatic increases in residential phone line connections; and by using subsidized concessions (allocated based on lowest subsidy bids), rural service expanded into 5,000 towns that were previously without service (Cannock 2001). Reforms in Argentina increased the number of power generators from 13 to 44 between 1992 and 1997, leading to a 40 percent reduction in electricity prices to households. Prices for water and sanitation services in Buenos Aires fell 17 percent. The 1994 liberalization of the long-distance telephone market in Chile decreased prices more than half.

Although energy generation and telecommunications infrastructure projects have clearly drawn greater private sector interest, infrastructure related to trade (ports, railways, and other transportation) has also seen private sector investments and improved efficiency. Regardless of the specific type of project, one lesson from the experiences of the impact of infrastructure investments on household welfare is that introducing competition for concessions and the threat of the entry of other providers supports better service provision, especially to the poor. For urban transport, telecommunications, water supply, and other services, auctioned concessions of more limited geographic exclusivity and shorter duration are potentially more efficient than the long-term, widespread exclusivity once routinely granted to monopolies (Brook and Smith 2000; World Bank 2001b).

An element determining the ability of rural communities to take advantage of reforms is their capacity to participate in prioritizing, implementing, and overseeing the results of infrastructure projects. The World Bank has emphasized that targeting poor households and areas is not easy, but it may be enhanced by improving the ability of communities to set priorities and monitor the provision of infrastructure services (Evans 2000). The World Bank has identified the use of social investment funds, for example, as a means to promote local infrastructure projects by aiding in organizing community partnerships.

But the decentralization of responsibility for infrastructure planning and monitoring requires greater consideration of the human capital bottlenecks at the local government level. One remedy is to support communities in information gathering and analysis and to support government agencies in their interactions with local groups, which often are less well educated with respect to technical aspects of project design and implementation (World Bank 2002c). Support to a community's human and social capital (which may be an ex ante prerequisite to an actual infrastructure investment[19]) can come in the form of facilitating local organizations, training local people involved in development planning and project design and monitoring, clarifying land ownership, improving land registries, and aiding in local governments' ability to obtain financing and better credit ratings.[20]

Despite the improvement in project design, execution, and monitoring, the effect on poor households and communities of national expenditures on increased infrastructure services may not be sufficient for reaching social goals related to poverty alleviation and the development of disadvantaged regions. The targeting of subsidies in the provision of infrastructure services is one method of addressing poverty and region-specific development goals, although

the form such subsidies might take is problematic. Infrastructure service subsidies for the poor are a short-term solution, and ideally, more economically efficient cash transfers would better serve the poverty reduction goal. (This is discussed in the following chapter.) But until there is a resolution to the problems of cash transfer schemes (design, administration, and political decision making), subsidies are often the second-best instruments available to include the poor in infrastructure reform benefits.

A conventional approach is the use of differential service charges based on consumption volume to attain cross-subsidization from more affluent to poorer ratepayers. This is not entirely consistent with the general trend toward relying on market signals, but the specific methods of applying differential charges (raising block tariffs and including initial block consumption in fixed charges) carry low administrative costs and are easily implemented. In many developing countries, however, the practical reality is that these types of rate differentials often benefit better-off households and sometimes may not benefit many of the poor (Barnes and Halpern 2000), in part due to the weak correlation between consumption levels and income and to the inappropriate setting of consumption blocks for pricing.[21]

One alternative approach is the use of targeted subsidization of projects for poorer communities. For example, competitive bidding for concessions has been used in Chile to induce firms to deliver electricity connections to rural households. Firms bid discounts on a maximum subsidy that is meant to augment a project's private returns when social returns are greater. The policy raised rural electricity coverage from 57 percent to 75 percent between 1994 and 1999 (Estache and others 2002). The logic of such a subsidy scheme is based on overcoming the high fixed costs of the initial connection of the electrical grid to clusters of customers in areas previously not served by the service. This is in contrast to focusing subsidies on the rates that customers pay for continuous service provision, once the initial start-up investments have been made. It should be kept in mind, however, that simply targeting subsidies to start-up projects for the provision of services, which were previously unavailable in disadvantaged areas, while addressing the large fixed-cost obstacles to private investments, does not resolve affordability questions of service charges to poor households that are associated with infrastructure already in place.

Of course, one difficulty with subsidizing certain projects is that once they are implemented, the rates charged for infrastructure services are not only insufficient to recover initial costs, but perhaps not even sufficient to recover periodic maintenance costs. Beyond direct measures of real household income, such as improved infant and child health due to water and sanitation projects, other external benefits may be pertinent in justifying government support, but the fiscal burden still remains. In a study of a number of rural water projects, for example, the World Bank study by Parker and Skytta (2000) finds that cost recovery was rarely attained, although a large proportion of beneficiaries were not the very poor.

While effective competition and effective targeting are major components of expanding coverage and improving the quality of infrastructure services for poor households and regions, there are other factors related to the abilities of communities and local governments to take advantage of reforms. Beyond incorporating into economic evaluation the effects in localities of such spillovers as health improvements and better education attainments, infrastructure policy design should also consider strengthening local community capacities, augmenting beneficiary participation, and reducing corruption[22] and subsidies to the nonpoor.

Nevertheless, as underlined by Leipziger and others (2003), infrastructure improvements could have an important role to play in achieving the Millennium Development Goals, and experience has shown that this could be of particular significance in reducing poverty and improving the welfare of poor households and underdeveloped regions in health and education. But with respect to specific projects that carry high fixed costs per resident, it is worth acknowledging that locating the final impacts is difficult, both in terms of poverty reduction and of overall regional development. For the purpose of focusing on the development of a particular region, orienting infrastructure policy towards attaining benefits tied to relatively immobile activities and persons would appear to have greater advantages, in addition to improving the ability to monitor the realized net project benefits or costs.

Infrastructure and regional development: Tougher rather than lax evaluation

Despite the significance of infrastructure services for national output, growth, and poverty, infrastructure investment is not a cure-all or even necessarily the best regional development instrument. By lowering input and transaction costs, certain types of infrastructure investments, such as communications and transport, are a means of strengthening the link between core economic activities and more remote territories. As the country case evidence shows,

farm-level returns are influenced by access to markets; but easier access, as well as improved education, also reduces migration costs out of a territory. And if the benefits to better infrastructure are not tied to relatively immobile economic activities and persons in an area, then there may be little contribution to overall regional growth, although it might still be beneficial for potential migrants. Simply increasing the infrastructure investment generally may not be sufficient to attain important territorial growth gains, because of the possible spillovers that the investment might have. This was illustrated empirically in the case of employment creation in Mexico in chapter 5, where econometric analysis found no significant telephone density effect on the localization of employment opportunities across states. Thus if territorial development is the public policy objective, then infrastructure investments should be designed with a deep understanding of the key sectors involved and their input and factor use.

The estimated payoffs to national output and growth are high when accounting for aggregate measures of countries' infrastructure, but, because the final location of benefits may be ambiguous, local returns of individual projects are often difficult to evaluate. In less dense and remote areas, infrastructure projects require high fixed costs per resident, but the eventual potential beneficiaries may not be simply those residents. Especially when thinking in terms of a specific region's development, therefore, infrastructure investment strategies oriented toward generating benefits that are tied to relatively immobile activities and persons would have theoretically greater payoffs to that region. This is an application of the key sectors' approach to regional development, where the key sector is characterized by the use of immobile factors of production.

Moreover, although one might predict positive but diffuse benefits, there is no guarantee that a project would really produce them; the uncertainty as to whether or not the project is producing the promised results would increase the importance (and the costs) of monitoring. But the ability to monitor a project's net benefits would be improved if it were linked more directly with activities and observable results in the territory to which it is targeted. The less diffuse a project's spillovers, the quicker it would be to detect a "white elephant" with fewer resources spent on monitoring.

Notes

1. The forthcoming regional study by de la Torre and Schmukler ("Access to Financial Services: Innovative Experiences") will look into specific experiences with new forms of interventions in financial markets.
2. World Bank 2004b.
3. Using population penetration ratios calculated from institutional details released by the Microcredit Summit (Daley-Harris 2003), in both global and national comparisons, the 30 top microfinance firms account for more than 90 percent of the clients served worldwide by the 234 top MFIs. Hence, penetration rates exceeding 1 percent of target population are extremely rare (Honohan 2004).
4. Honohan 2004.
5. "Financial Sector Policy and the Poor: Selected Findings and Issues, 2004," 23.
6. Skees, Varangis, Larson, and Siegel 2002.
7. Canning 1999; Demetriades and Mamuneas 2000.
8. Easterly and Rebelo 1993; Sanchez-Robles 1998; Easterly 2001; and Loayza, Fajnzylber, and Calderón 2003.
9. See, for example, Estache (2003) and World Bank (2003).
10. Lederman, Maloney, and Servén 2004.
11. A useful literature review is found in Willoughby (2002).
12. See the evidence of Jacoby (2000), who uses the net present values of crop production net income to serve as a proxy for the asset value of farm areas.
13. See, for example, Antle (1984), Binswanger, Khandker, and Rosenzweig (1993), and Zhang and Fan (2004).
14. Ravallion and Datt 1999; Fan, Hazell, and Thorat 2000.
15. Fan, Hazell, and Thorat 1999; Fan, Zhang, and Zhang 2000.
16. Behrman and Wolfe 1987; Lavy et al. 1996; Lee et al. 1996; Jalan and Ravallion 2002.
17. De Ferranti et al. 2002.
18. In 1998, private financing for infrastructure represented about $35 billion in investment, of which $14 billion was directed to telecommunications and $12 billion to transport.
19. See Parker and Skytta (2001), and Coitéis-Wahl and Meunier (2001).
20. World Bank 1998; Parker and Serrano 2000.
21. For a summary of infrastructure service targeting and the difficulties of targeting by differential tariffs in the context of the Latin American and Caribbean region, see Estache, Foster, and Wodon (2002).
22. Privatization may also have the effect of dealing with corruption in government-operated infrastructure service provision, as is discussed in the case of the energy sector by Lovei and McKechnie (2000).

CHAPTER 8

Promoting Economic and Social Development in Poor Regions: Direct Income Supports, Environmental Services, and Tourism

AGRICULTURAL TRADE AND R&D INFLUENCE PRIMARILY RETURNS TO FARMING. RURAL land policies generally influence the incentives and the availability of funds for both working capital and longer-run investments attached to the land. Rural finance and infrastructure determine the ability of communities to make the most of all rural activities. But some households and regions will not be able to take the same advantage of new developments in the international trade regime, new technologies, cheaper credit, crop insurance, and improvements in a country's roads, telephone networks, and other public infrastructure. Some households and communities will lag behind in rural and national growth because they do not have sufficient assets that complement these developments.

This chapter reviews policies that could aid these households and communities. Especially due to changes in the rules of international trade and the likelihood of continued trade reforms, the chapter begins by addressing the question of programs that offer nonproduction-related income support to producers of import-competing goods. Such schemes would reduce the political opposition to moving toward more open trade, by shifting the source of support for farmer incomes from border protections to government outlays and so easing the transition to domestic prices that are more closely aligned with world prices. But due to the objectives underlying such compensation schemes, they would not necessarily aid the poor farmer significantly, and even less the rural nonfarm poor who live in areas that are lagging behind in development. The chapter discusses other forms of government transfers to poorer households specifically, which are based on family characteristics. Such support could be justified whether or not a rural area's farmers might suffer with trade reforms.

The chapter then turns to other types of policies targeted to remunerating rural households and communities for their contributions to generating positive environment externalities, and giving them additional income sources beyond the traditional production of standard rural natural resource (RNR) products. In addition, public support in fomenting tourism is reviewed as a means of aiding rural communities in diversifying their income sources in places where a traditional focus on RNR production is unlikely in the future to be a source of alleviating poverty and an area's underdevelopment.

8.1 Compensation for trade liberalization and targeted anti-poverty support[1]

With the global move toward more open trade, the reduction of market price supports and output payments has led many governments to make use of programs that provide income supports for rural areas through payments meant to be unconnected to farm production decisions. These programs, such as direct income supports and conditional cash transfers, are recognized as a form of compensation to farmers and other groups for the negative consequences of ending or reducing border protection and production subsidies due to the adoption of free trade agreements and other reforms. But more generally they are a possible form of direct support to the incomes of rural households that lack the assets to make use of other measures meant to improve a rural area's economy, whether or not they are connected to farming and whether or not they live in rural areas that stand to lose from border protections. Aside from questions of compensation for trade reforms, these types of policies can also be applied in areas of low farm productivity and of few alternative activities that lag behind the rest of the economy.

In lieu of the sometimes-dubious attempt to alleviate rural poverty through the protection of agricultural production, direct payments can be targeted to the poor and to the farmer (of whatever income level), while minimizing the distortions in price signals that guide production decisions. But with respect to farmers specifically, such income supports can ease the transition to a more efficient agricultural sector. In WTO terminology, these are "decoupled" payments, so called because they are disconnected from the use of inputs, such as land and fertilizer, and the production of particular crops. They are of specific interest to the WTO and trade analysts because they are meant to be neutral with respect to international trade, reducing the distortions between domestic and border prices. Decoupled income support (DIS) programs and conditional cash transfer (CCT) programs have been used successfully in OECD and Latin American and Caribbean countries to compensate farmers for the reduction in protection, to smooth consumption during economic downturns, and to alleviate poverty directly in rural areas.

Of course, the adoption of income supports as compensation for once-protected farmers might even be unnecessary, if there is a gradual reduction in protection that takes place over a large number of years (say, 10 to 20 years, as has been in the case of some products under bilateral and regional agreements). And it is possible that the introduction of these support programs might be unwise in any case, if a government's institutional capacity is too weak and open to corruption to implement such programs. Prior to adopting any income support program, considerable attention ought to be paid to identifying the circumstances where those policies would, in fact, act to alleviate the poverty of rural households or to compensate farmers for real harm due to the reduction in price protection, and where successful implementation would be possible. Moreover, although compensation should be temporary, experience has shown that transfer policies are usually difficult to terminate.

Decoupled payments: Direct income supports for farmers

A decade ago, the GATT Uruguay Round sought to limit domestic agricultural price supports to farmers and government expenditures on production subsidies. But there were some exemptions, one of which was that domestic supports were permissible if they had no (or minimally) distorting effects on production and international trade. Such permissible supports should be funded directly by the taxpayers and not indirectly by consumers, and they should not have the effect of providing price support to producers (see box 8.1). In principle, these direct income supports, decoupled from production decisions (for example, by the use of fixed yields and land area as basis of payment), could serve as compensation programs to ease the political resistance to reducing trade distortions.

In the 1990s, OECD countries, particularly the EU and the United States, introduced decoupled payments to shield farmers from the loss of tariffs and other protections, and explicitly so. The EU's Common Agricultural Policy (CAP) in 1993 and the United States' Federal Agriculture Improvement and Reform (FAIR) Act of 1996 contained direct income supports, although decoupled payments still are less than half of total support (30–40 percent).[2] In developing countries, Mexico and Turkey have both introduced DIS programs, Mexico as a part of joining NAFTA in 1994, and Turkey as compensation for the elimination of price supports, tariff reductions, and the reduction of an input subsidy in 2001. While there are some similarities in program design and implementation between OECD and developing countries, significant differences occur in the payment basis, record keeping, and monitoring, which to a large extent reflect differences in information availability and the details of payment schemes.[3] Furthermore, OECD countries have had a long history of domestic support programs, in addition to tariff and nontariff protection.

BOX 8.1

Direct payments to producers

To be "decoupled" or de-linked from production decisions, direct payments shall meet the following criteria:

- Eligibility for such payments shall be determined by clearly defined criteria such as income, status as a producer or landowner, factor use, or production level in a defined and fixed base period.
- The amount of such payments in any given year shall not be related to, or based on, the type or volume of production (including livestock units) undertaken in any year after the base period.
- The amount of such payment in any given year shall not be related to, or based on, the prices, domestic or international, applying to any production undertaken in any year after the base period.
- The amount of such payment in any given year shall not be related to, or based on, the factors of production employed in any year after the base period.
- No production shall be required to receive such payments.

Source: WTO definition of Green Box payments.

Decoupled programs that provide transfers to farmers do not have poverty alleviation in rural areas as a primary objective. In OECD countries, farmers are not the poor and are often better off than urban residents. Although in developing countries many of the poor have benefited from decoupled payment programs, the lion's share of program expenditures have gone to large farmers. Payments are based on past production levels and area planted, favoring large commercial farmers producing for the market. Most decoupled programs have ignored landless workers who may also suffer from the reductions in agricultural production and in employment opportunity that result from the elimination of domestic price supports. For these workers, conditional cash transfers or workfare programs for specific rural areas would be more effective than decoupled cash transfers.

Direct income supports: PROCAMPO's effects on income, consumption, production, and equity

Mexico's PROCAMPO is a Latin American and Caribbean DIS program worth examining in more detail. Mexico's agriculture has traditionally been a highly protected sector, enjoying tariffs, guaranteed purchases by marketing boards, minimum guaranteed prices for many basic crops, input subsidies, and other forms of support. In 1994, Mexico introduced direct income payments to compensate farmers for the adverse effects of NAFTA reforms. In fiscal year 2002, PROCAMPO benefited 2.8 million producers, covering 13.7 million hectares, and representing almost all the country's cultivated land—at a cost of $1.2 billion.

Studies[4] have found that PROCAMPO serves well as a counter-cyclical tool to address the impacts on farmers of economic downturns. In 1994, for instance, estimates indicate that without PROCAMPO payments, income would have otherwise declined by about 4 percent. By 1997, the average program payment was $317 annually, representing on average 8 percent of *ejido* (small land plots that are part of community-owned land) household income. But for the poorest tenth of the population, the contribution was approximately 40 percent. Panel data research on PROCAMPO's net impact have shown that, controlling for other factors, the program reduces the probability of an ejido household being poor by 10 percent. These payments to farmers also have multiplier effects. Although estimated multipliers vary by household characteristics and region, for every peso received by a household in the ejido sector, an income of 1.5 to 2.6 pesos is generated, on average. Surveys also indicate that producers would devote about two-thirds of PROCAMPO subsidies to financing production and the remaining third to family consumption.[5]

The program, however, appears to not have contributed to modernizing the low-income farm sector (World Bank 2003). About 50 percent of cultivated land grows low-value corn, and yields of rainfed grains remain constant. This might be attributed, in part, to a reduction of the subsidy's real value, in pesos and dollar terms, of almost 50 percent. But the primary reason appears to be the lack of reforms to public and private monopolies in energy (diesel), marketing, transport, and other markets, which raises costs and reduces the rural sector's competitiveness.

PROCAMPO has had important redistributive effects. First, each of approximately 170,000 farmers producing on less than one hectare receives payments as if he had one

hectare. Second, payments provide special liquidity to small farmers. In 2002, payments prior to sowing time benefited 2.1 million producers with 6.1 million hectares, at a cost of $642 million.[6] Third, because the subsidy is the same per hectare for all producers, small farmers, who are typically net food buyers and sometimes produce very little for the market, are "overcompensated" for price reductions due to freer trade, and larger commercial farmers are "undercompensated." Despite this pro-equity program design, and because land distribution is highly concentrated, a high proportion of subsidies is given to a minority of larger farmers (over 5 hectares). About 45 percent of small producers (less than 5 hectares) receive only about 10 percent of total payments (World Bank 2003).

Implementing DIS programs

While decoupled payments have proved to be a good alternative for providing nondistorting, incentive-neutral, and welfare-enhancing support to farmers and have been accepted politically by farmers in most countries, they do not guarantee that pressures will cease for maintaining past support measures—border protection, price supports, and credit subsidies. In fact, as experiences in the United States and Mexico have shown, price distorting support measures may be reinvigorated *and* the decoupled support program may be extended, due to a change in the political environment. This suggests that the sequencing of introducing decoupled support measures should be carefully considered to avoid double dipping by farmers at a cost to taxpayers and consumers.

Designing and implementing decoupled payments requires adequate planning and pilot testing, especially in countries without previous experience in direct government supports and weak administrative capacity. This may be the case in most Latin American and Caribbean countries, where historically most support has been through border protection and input and credit subsidies. The design of decoupled payment programs should give the highest priority to simplicity, transparency, extensive information, and compliance with rules, including making payments on time to ensure program credibility. The best registries are those that rely on cadastre records, cover all crops and agricultural land rather than cultivated land in specified crops, and do not require cultivation for eligibility for the subsidy. Covering certain rather than all crops and requiring cultivation requires verification and land measurements, which are difficult and costly to do, either manually or by satellite technology, and it also is contrary to the idea of "decoupling."

Poverty-focused payments: Conditional cash transfers

CCT programs are the most successful rural poverty safety-net programs that are being implemented in Latin America and the Caribbean and many other countries. These programs provide sometimes-significant cash support to poor families residing in selected rural areas. In exchange, these families send their school-age children to school and obtain regular health checkups and vaccinations for children under five years of age. The rationale is that poor rural families often do not have the resources to pay for the direct costs of school or going to health centers and have high opportunity costs to send children to school. Cash transfers have the dual objective of providing immediate short-term assistance to families so that they can improve consumption and nutrition, and of supporting long-term human capital investments in children. A key feature of these programs is that governments also simultaneously invest in social infrastructure to ensure families of better schools and health services.

Although CCT programs have been introduced to provide *income-based* rather than *farm-related* support for rural families, they may be also be candidates for compensating rural farmers and landless workers for loss of employment or income resulting from tariff reductions and loss of protection in Latin American and Caribbean countries. Traditional direct-decoupled payments, which provide benefits on the basis of past production and of cultivated land, fail to address the issues of landless workers, who may lose employment opportunities, and of families working in disputed areas without land titles or rent contracts. CCT programs can be properly targeted to areas either producing certain import-competing crops that are more affected by tariff reductions, or where landless workers are more prevalent and there are few alternatives to work outside farming.

CCT programs have been recently introduced in a number of Latin American and Caribbean countries including Brazil, Colombia, Honduras, Jamaica, Nicaragua, and in other countries such as Turkey. Most programs share a similar design, drawing on cross-country experiences and evaluations. They have three common features: (1) implementation is focused on poor rural areas that produce basic foods for consumption or for the market in small plots; (2) payments are based on the number of children in a household, which provides larger subsidies to poorer, typically larger families and establishes a basis of exit from the program as children grow older and lose eligibility; and (3) they have the goal that program continuation should be contingent on its

TABLE 8.1

Design features of CCT in Latin American and Caribbean countries, 2002

Country/program	No. beneficiary (000)	Start date	Type of benefit	Subsidy/ family/ yr. (US$)	% of household spending	Budget, US$ (% of GDP min 2001)
Mexico (Progresa–Oportunidades)	4,200	1997 (rural) 2001 (urban)	Health/Nutrition grants: Lump-sum per household; plus nutrition supplements for children 0–5 yrs. old, and pregnant, lactating women. Education grant: Cash for 6–17-yr.-olds, plus supply-side spending.	380	21	$2.3 billion (0.32%)
Brazil (Bolsa Escola, BE and Bolsa Familia, BF)	BE: 3,700 HH (2003) BF: 3,600	1995 (BE) 2003 (BF)	Transfer to 6–15-yr.-olds conditional on school attendance. New BF program merges four programs. Transfers conditional on education, health, and nutrition.	85 (BE) 290 (BF)	5 (BE) 19 of PL (BF)	$800 million (0.15%)
Colombia (Familias en Acción)	315	2001	Nutrition grant for 0–6-yr.-olds; education grant for 7–18 yr.-olds.	260	15 of MW	$83 million (0.12%)
Nicaragua (RPS)	10	2000	Nutrition grant for 0–5-yr.-olds. Education grants for 6–13-yr.-olds in 1st–4th grades; plus supply-side spending; in health and nutrition with paid NGOs.	236	18	$5 million (0.02%)
Honduras (PRAF)	51	2000	Health/Nutrition grants: Cash plus supplements for pregnant women and 0–2-yr.-old children. Education Grants: Cash for 6–13-yr.-olds. Plus supply-side spending.	110	<5	$8 million (0.2%)

Source: Castañeda (2004) calculated from data in Coady (2003).
Note: PL = poverty line; MW = one minimum wage; HH = households.

impact on the economic and human capital development of the poor.

In Brazil, Colombia, Honduras, Mexico, and Nicaragua, by the end of 2002, CCT programs benefited more than 10.5 million poor families, most of which resided in rural areas. Total fiscal costs were of over $3.2 billion, representing about 0.2 percent of the countries' combined GDPs (see table 8.1 and box 8.2). Most of the CCT programs were introduced in 2000–1 (except PROGRESA, which was introduced in 1997) after a major crisis hit the region, and governments responded by providing a safety net for the poor, especially in rural areas where the poverty incidence is sometimes over 70 percent. The annual average benefit per family ranged from about $110 per household (or less than 5 percent of household expenditures) in Honduras, to $380 (about 20 percent of household expenditures) in Mexico.

CCT programs have been effective in smoothing consumption during crises, in improving both school attendance in primary education and the rate of progression from primary to secondary education of beneficiary children, and in improving health services, vaccination rates, and growth monitoring activities for small children and pregnant women. They have had a significant impact on the nutrition of poor recipient families, compared with similar families not receiving the benefit. In addition to consumption, families can use the transfer money for production activities, if they choose.

BOX 8.2

CCT programs in Latin America

In ***Mexico, Oportunidades*** began in 1997 to improve the coordination of programs for the extreme poor and to help families build the human capital of their children. The program provides direct bi-monthly cash transfers to families conditional on sending children to school and on children receiving health checkups and basic health care. It also provides food supplements to undernourished or at-risk children. The program benefited 4.2 million families at a cost of $2.3 billion in 2003. Until 2000, the program covered only rural areas identified through poverty maps using a marginality index. In 2001, the program was extended to urban areas.

Participating families are selected using a two-step targeting strategy that combines geographic and household characteristics. For rural areas the first step consists of selecting poor areas on the basis of census-based poverty maps. In the second step, families are selected in these areas using a proxy-means test on the basis of poverty scores produced by statistical models. For the recent program expansion into urban areas, families are selected from poor urban areas that apply for the program and meet accepted poverty scores levels. Because subsidies are calculated per child below five years and per child in secondary education (with larger subsidies for girls), the subsidy is weighted toward the poorest.

Program evaluations have indicated a significant impact on beneficiary families relative to families in control groups: 80 percent of benefits go to the poorest 40 percent of the population; there are increased progression rates in primary education; in secondary education, there was an 8 percentage point increase in female and 5 points for male enrollment; the secondary-level grant incentive is 10 times more effective at producing enrollments than investments in infrastructure; there are improvements in consumption, health, and nutrition (70 percent of households increased quantity and quality of food); there is decreased illness for both children and adults; and there is increased child height and reduced anemia in children 24–48 months (–19 percent).

In ***Brazil, the Bolsa Escola*** program began in Brasilia and Campinas in 1995, providing transfers of about $5 per child per month (with a maximum of $15 per month) for children 6–15 years and conditional on 85 percent school attendance. The transfers cover about 5 percent of total consumption in the poorest two deciles and are paid to the child's mother. In 2001, the program covered about 10 million children from 6 million households (17 percent of the population) at a cost of about $680 million (0.15 percent of GDP).

In 2003, Bolsa Familia merged four previous cash transfer programs that were operating for roughly the same target group of the rural poor. Its objectives were to reduce poverty "today" through direct transfers and reduce it "tomorrow" through incentives for human capital investment in beneficiary families. Monthly transfers average $290 per year per family, about 19 percent of the World Bank's poverty line, or 6 percent of the minimum wage. This is a high-cost program (3.6 million families ending 2003, 11 million ending 2006—about $11 billion over 2004–6). It is unlikely that Brazil can afford national direct income support to farmers as well. One strategy would be to use Bolsa Familia for high-priority poor areas or families most affected by the loss of agriculture protection.

In ***Colombia, Familias en Acción*** is a program modeled on Oportunidades and other similar programs in Latin America, with the objective of providing a safety net for poor families during crisis, while addressing child development. The program provides cash transfers to address current consumption needs (about $43 every two months), conditioned on health checkups for children six and under, and school for 7–17-year-olds. Ending 2002, the program benefited 315,000 families with over 800,000 children at an annual cost of about $83 million. Once selected, the family stays in the program for three years if they meet established conditions. A recent program evaluation concluded: about 90 percent of beneficiaries have consumption levels below the poverty line; there has been a significant increase in high-nutrition food consumption; a school enrollment increase of 14–17-year-olds, especially in rural areas; an increase in growth monitoring and vaccinations for young children; and reductions in acute diarrhea.

In ***Nicaragua, Red de Protección Social*** was created to operate a pilot conditional cash program in late 2000. There are two transfers: one for primary-school-age children and one for all participants. Cash transfers are planned to raise household income sufficiently to permit the average household in the region to access a minimum food bas-

ket. Beneficiary households are required to take part in an NGO-provided health education program, to attend child growth and development monitoring sessions, and to keep vaccinations up to date. The transfer has a fixed value of approximately $19 per household per month. By the end of 2003, the program was covering about 10,000 families.

The program operates in two of the country's 17 departments, selected for their high poverty rates and good access to schools and health centers. Forty-two *comarcas censales* or census tracks (over two-thirds of the total) with the worst marginality indices were considered eligible to receive the transfers. Of the 42 eligible comarcas censales, 21 were selected by lottery to actually receive the transfers. Virtually all (97.5 percent) households in the 21 comarcas censales are eligible to receive the transfer, the exceptions being those (that admit to) owning a vehicle of some kind or farming more than 14 hectares of land.

A recent International Food Policy Research Institute (IFPRI) impact evaluation found: a large redistributive impact (the poorest 40 percent received 81 percent of spending); enrollment increased from 69 to 87 percent; grade progression increased by 7.2 percentage points; per capita food expenditure increased by 22 percent; attendance of young children at health clinics increased by 11 percentage points; stunting of the very young decreased by 5 percentage points and the underweight by 6 percentage points; and the very young receiving iron supplementation increased by 31 percentage points.

In ***Honduras, the Family Allowance Program*** (PRAF) began in 1991 to compensate poor families for the economic adjustment program's adverse effects. The program started with a pilot program providing food stamps to families conditional on sending small children to school and obtaining health checkups and vaccinations for the very young. Food stamps were distributed at health centers and at schools. By yearend 2000, the program was restructured under an IDB loan to implement a program of household cash transfers (PRAF/IDB Phase II) covering 40 municipalities with a total population of some 400,000 persons. The phase II interventions comprise two distinct transfers: for primary-school-age children and for pregnant women and children under three. All households in the 40 municipalities with young children or pregnant women are eligible. One distinctive program aspect is supply-side expenditures to improve education, and health and nutrition services that were absent from the original project design.

A recent IFPRI midterm evaluation concluded:

- The poorest 40 percent received about 79 percent of program benefits.
- There was no evidence of impact on enrollment rates (which were already high).
- Antenatal care visits increased by 19 percentage points for households receiving only the cash transfers.
- Post-childbirth checkups increased by 5 percentage points for households receiving only transfers.
- There was little evidence of any impacts on nutritional indicators (probably because transfers are very small—less than 5 percent of expenditures—and irregular, and nutrition supplements had not been distributed).

Source: Castañeda 2004.

Evidence from Mexico indicates that the CCT program PROGRESA has led to families investing in their own businesses and alternative income-generating enterprises (Davis et al. 2002). CCT transfers are more effective than decoupled land-based payments to farmers are in transferring fiscal resources to poor families. They are effective in the prevention of the stress migration of poor rural families without land and in children's school retention. They are all the more effective in the absence of unemployment subsidies, workfare programs, or other safety programs that are generally not implemented in rural areas.

Lessons for direct support programs for farmer and nonfarmer rural households

Experience suggests that DIS programs directed to farmers cost about the same per farm household and accomplish about the same degree of consumption smoothing and income support as do more-recent CCT programs directed at the rural poor. As compensation for lowering protection to agricultural production, they both have an advantage over other safety-net programs: they are more politically acceptable as compensation for lower protection because they tend to reach a wider range of farmers. While they

could provide significant support to farmers' incomes (and thus could be a means to alleviate poverty), other complementary programs—such as noncontributory pensions to the elderly poor and unemployment insurance—could be implemented as well.

In view of fiscal constraints, one would want to avoid program duplication in targeting similar populations. While poverty alleviation experts will favor CCT programs for their proven record of improving education, health, and nutrition of the rural poor, it is not always possible—for political or other reasons—to target all subsidies to the poor. Governments are often under pressure to support all farmers, including large commercial farmers and corporations. Given such a constraint, DIS programs are potentially an efficient alternative to consider. In practice, a government's best policy strategy may be to combine DIS and CCT programs to make use of their respective advantages, without overlapping coverage.

DIS programs are more appropriate when the target population is mostly farmers who own their land and have property titles, when good cadastral records exist, and when there are few landless workers. CCT programs, in contrast, are more appropriate in rural areas where there is a high incidence of poverty and a large proportion of landless workers and of small producers working off-farm, and there are acute education, health care, and nutrition deficiencies.

From international experience, the most efficient DIS programs require simple designs to reduce implementation problems, lower costs, and respond quickly to compensation objectives. This suggests three good design characteristics:

(1) All crops should be included. This avoids changes in farmer decisions to take advantage of the scheme and would be especially important if the program is announced beforehand, allows for pilot testing and gradual implementation, and permits late entrants in poor areas.
(2) Cultivation should not be required, reducing the need for resources to monitor compliance that could otherwise be used in, for example, extension activities. Fully decoupled payments, in fact, should have no effect on production of particular crops, because payments should have no effects on prices, input use, or technology choice.
(3) Cadastral records—rather than self-reported planted areas—should be used for determining area payments, making program records more transparent and less subject to manipulation and corruption.

8.2 Policies to enhance the contribution of rural environmental services

What are environmental services? The term refers broadly to the provision by natural systems of a flow of goods and services to society in contrast to similar (and substitutable) services from manmade infrastructure and technologies (such as water treatment). Ecosystems are assets, a form of natural capital that provides services to the economy and society beyond serving as a base for the production of crops, wood products, and the like. Their capacity to produce environmental services can be enhanced or degraded by their management quality, and one tool to incorporate the economic value of these services into the decisions of producers and consumers is the use of market-based mechanisms. Environmental services can be grouped into those associated with productive activities, such as farming and forestry, and those that are directly consumed, such as outdoor recreation. They can also be classified as producing immediate benefits—air and water purification—or providing an option for future service provision, such as biodiversity.

As major activities in most nonurban areas, agriculture and forestry can also be viewed as both consumers and sources of environmental services. The rural natural resource sector is a consumer of services related to pollination, nutrient cycling, and pest control; a source of carbon sequestration, landscapes, tourist attraction, animal habitat provision, air and water purification, and the mitigation of droughts and floods (Heal and Small 2002). The problem of environmental service management associated with rural natural resources is not so much one of being inherently undervalued by individuals and societies, but instead a problem of aligning the incentives of private agents in the presence of externalities and public goods. Thus the main policy challenge is the design of institutions that provide accurate information and appropriate incentives regarding potential social benefits and costs of agricultural practices. Possible policy instruments include environmental taxes, mandated best practices, property rights allocation, and support for institutions for common property management. More recently, policies have been implemented that emphasize markets and government support through subsidies of environmental goods and services. The increasing attention given to this topic by policy makers and environment and development circles is evidenced by the World Bank's participation in programs offering payments to environmental services (PES) (see table 8.2).

TABLE 8.2

World Bank support for PES programs

Project	Country
Ecomarkets	Costa Rica
Regional Silvopastoral Management	Colombia, Costa Rica, and Nicaragua
Western Altiplano Natural Resources Management	Guatemala
Technical support for national PES program	Mexico
Canaima National Park	R.B. de Venezuela
Cape Action Plan for the Environment	South Africa
Pilot PES projects	Dominican Republic, Ecuador, and El Salvador
Capacity-building courses	Ecuador, Mexico, Panama, Peru, Senegal, South Africa, and R.B. de Venezuela
Carbon markets	General

Source: Fleischer 2004.

Taxes and best practices

The planning of effective policy interventions requires an understanding of possible private incentives to protect the environment. For example, farmers in particular derive benefits from the linkages between resource conservation and farm productivity. This incentive gives rise to the stewardship[7] of natural resources, which policies may modify, enhance, or debilitate. In particular, farming's role in soil degradation, in the form of waterlogging, salinization, and erosion, is a serious problem in Latin American and Caribbean countries. But stewardship incentives for maintaining soil quality may be undermined in some countries due to poorly operating credit markets and lack of clear property rights.

Environmental taxes have received an extensive treatment in the economics literature but have rarely been implemented. Because of the high cost of monitoring emissions in agriculture (and in rural areas more generally), policies that require this information, such as the use of emission charges, are not generally considered practical measures; when they have been used the main motivation was fiscal revenues. Emission permits have been implemented in some countries, but tend to be pollutant-specific, with little observed trading. Best management practices mandate the use of agricultural and forestry practices that reduce negative environmental impacts and are particularly well suited for nonpoint pollution problems. They may come in the form of specific guidelines, restrictions on productive operations, or general rules. In developing countries, their use in the past has been limited, but they are becoming more common for the management of native forests and in connection with environmental quality certifications for export markets, a form of bundling agricultural products with environmental services. Because government design and enforcement of mandated practices may be inefficient, especially for products aimed at foreign buyers, private third-party certification and voluntary implementation are feasible methods of implementing these practices.

Restrictions on input use are a direct form of reducing negative environmental impacts, but given the considerable heterogeneity in rural natural resources and especially among farm practices, uniform rules on input use tend to be inefficient. Input taxations might be more appropriate means of reducing the use of environmentally harmful inputs, but they are politically costly and have not been widely implemented. Alternatively, subsidizing inputs that benefit the environment is a policy used in many industrial countries to increase environmental quality provided by agriculture. Examples are payments to maintain wildlife and natural landscape, and lower property taxes for rural areas.

Common property as a way to manage externality problems

In many Latin American and Caribbean countries much land remains as public property or under communal management. Market integration and globalization can bring about increased pressure for land privatization in what has been called "a race for property rights," and Lopez (2002) points out that this "race" creates incentives for excessive or accelerated intensification, producing inefficient deforestation and soil degradation. The efficiency losses associated with this process would endure if the resulting natural capital degradation is large. Thus policies that make a smooth institutional transition—between public or communal land and private property—should be designed to avoid transitional and permanent inefficiencies. As pointed out by Holden and Binswanger (1998), under uncertain property rights, higher output prices may accelerate deforestation when this represents a way to acquire property rights

(homesteading). What makes this problem even more complex to solve is that land titles in and of themselves are not enough; to be effective, they should be accompanied by proper cadastral information and an effective system for the resolution of disputes, which is lacking in several countries in this region.

Common-pool resources provide many environmental services, and avoiding their degradation depends on the success of their management by a group of owners, often the same community that uses the resource. Ostrom's (2002) study of institutions that have been successful in managing natural resources has led to principles that can be used in policy decisions. Although many of these are applied to self-governed institutions, some also apply when governance is mixed, that is, when some of the rules come from external authorities.

First, it should be clear who or what group has rights over the resource and what its boundaries are. This is typically not the case for international fisheries or forests that can be accessed by more than one community. Fairness in resource extraction and the allocation of exploitation costs are also key factors in implementing successful institutions. When participants consider that the management scheme is unfair, they are less likely to comply with the rules. This also happens when rules are not modified with direct participation of most of the interested parties. Because in most cases there will be individual incentives to cheat, monitoring the resource's condition as well as individual behaviors is an essential aspect of any management scheme.

A premium on being environmentally friendly

Subsidizing best practices for environmental protection is also common in industrial countries, and examples abound due to its WTO acceptability as an income support vehicle. The USDA/CRP program, where farmers apply for payments linked to land retirement, is the most notable and expensive case, but similar approaches have been implemented in some developing countries for watershed conservation services associated with reducing soil erosion. As Lutz, Pagiola, and Reiche (1998) point out, however, in many cases the cost of erosion-control measures outweighs their direct benefits and would not be justified without significant offsite benefits (downstream externalities). For example, a USAID-funded project in Guatemala subsidized farmers to build terraces and reduce the flooding risk to the historic town of Antigua. Farmers normally used cheaper erosion-prevention methods but were not accounting for the flooding risk. Using subsidies in these cases may be justified, but their use is not without limitations. The extent of the externality must first be estimated—a nontrivial task—to shape appropriate incentives. Many times, only the initial investment is subsidized and then the lack of funding for maintenance leads to a fast system degradation. This has happened in the Managua watershed, Nicaragua, and Tierra Blanca, Costa Rica.

Probably the organic products market is the best-known example of a market that takes into account the environmental services associated with an agricultural product. Because a "more natural" production product relies less on external inputs, organic produce incorporates environmental services to a greater degree. Another environmentally friendly case is the increasingly common production of shade-grown coffee in Mesoamerica.[8] This coffee is produced on farms that remove considerably less of the natural forest, thus keeping intact most of its environmental services, such as biodiversity conservation. A certification process ensures coffee buyers of the product's environmental soundness for a price premium. Watershed protection is another environmental service that can be provided through agricultural practices or forest conservation, and municipalities and water utilities have an incentive to pay for this type of practice that results in less pollution, lower fluctuations of water flows, and diminished flooding risk. Dams and reservoirs can also reduce sedimentation when erosion control practices are implemented upstream. A case in point is in Quito, Ecuador, where a grant was established to fund investments and the operational costs of a plan to protect the watershed that provides water and hydropower, among other services, to the city.[9]

The Costa Rican experience, beginning in 1997, is perhaps the most studied of government policies dealing with payments for environmental services[10] and has generated similar efforts in other Latin American countries.[11] The National Forestry Financing Fund officially acknowledges that forest owners provide a bundle of environmental services, including watershed protection, biodiversity conservation, scenic beauty, and carbon fixation and sequestration. The PES system arose due to the government's desire to find sustainable funding sources for both forest conservation and support of forestry sector activities. Evolving out of previous incentive schemes and institutional frameworks arising in the 1970s aimed at subsidizing the sector and reforestation (and abandoned with structural adjustment), the Costa Rica PES program has contracted over 280,000 hectares of forests,

with more than 800,000 hectares pending, spending $57 million between 1997 and 2002.[12]

The program's emphasis on forestry and its technical and land titling requirements tended initially to exclude small farmers and indigenous communities. The program has been adapted to encourage greater participation of indigenous reserves, and agriculture has taken on a larger role with the program's inclusion of agro-forestry systems. Of all contracts, 83 percent have been for forest conservation, paying over $210 per hectare, and 7 percent are for reforestation, paying the considerably higher amount of $538 per hectare.[13] PES funding has come mainly from fuel taxes, but also from the international community (World Bank and GEF) and local hydroelectric power plants. Those paying the taxes are unlikely to connect their fuel purchase decisions to environmental improvements, and so the system is not a true market for environmental services. But the PES is a market-like method for allocating funding to support environmental services and is worthy of further study and analysis.[14] Furthermore, there are benefits and services provided by ecosystems other than forests, such as wetlands, and areas where crop and livestock production takes place. For example, orchards and coffee plantations contribute to carbon sequestration and well-maintained farms to scenic beauty, less soil erosion, and downstream water quality. Although the current PES focus is on natural ecosystems, other land uses could enter into future similar schemes.

PES policy discussions have been largely focused on their effectiveness at achieving environmental objectives, although they do have consequences for rural communities and the livelihood of the poor. Experience with PES programs emphasizes that they are primarily instruments for more cost-effective realization of environmental goals associated with specific services. While the PES can be a part of broader policies aimed at alleviating rural poverty, they are aimed at affecting large-scale ecosystems with fewer actors as a way of avoiding high transactions and monitoring costs and thus tend to emphasize private property rights and to target landowners.[15] The implications with respect to rural communities are not the center of attention, but are the result of the specific program context. By enjoying clear ownership over geographical areas essential to the generation of the targeted environmental services, communities will gain. For communities where ownership rights are weak, PES programs are less beneficial, perhaps even undermining access to natural resources.

Private national parks and conservation of native forests and biodiversity

In some Latin American and Caribbean countries there is increasing participation of private agents in the conservation of native forests, biodiversity, and landscapes. National park services are often underfunded and lack the capacity to offer many of the environmental services that could be derived from this land. Privately protected areas offer an alternative form of providing environmental services. Some have restricted access as decided by their owners, but others are now open to the community at large.

For example, in Chile, in addition to publicly protected areas covering 14.2 million hectares, Corcuera et al. (2002) cite that in 1998, there were 93 privately protected areas covering a total of 325,000 hectares. This does not include the largest and best-known private park in Chile, Pumalín, in the south of the country, which, at least until recently, covers approximately 300,000 hectares in Patagonia. U.S. millionaire Douglas Tompkins purchased it in 1991, specifically as a conservation reserve, and he recently acquired another large ranch, including native forests. As a person with connections to the deep ecology movement, his main motivation apparently is conservation per se. There were, however, 12,700 visitors to this reserve in 2000. Its tourism and management infrastructure clearly surpasses that of most national parks.

Scenic landscape preservation, biodiversity conservation, carbon sequestration, and watershed protection services are among the main public benefits that these initiatives generate. The social benefits of such initiatives could be enhanced with policies guiding and supporting these private initiatives to maximize public interest. For example, a higher impact on biodiversity conservation could be achieved if incentives were established to match a national (and possibly global) conservation priority. Also, coordinating efforts to avoid high fragmentation levels may yield higher conservation returns on privately protected areas serving as corridors or a buffer zone, or in geographically large conservation areas. Lacking is scientific information that can guide such management. One government role would be to subsidize research and to train private managers to enhance the provision of public environmental services in these privately developed national parks.

Final reflections on environmental services

There is general public support for environmental services. But with some exceptions, the reality in most countries is

that environmental service policies are infrequently implemented in an effective manner. They are generally costly and difficult to implement, and require specialized information and an effective institutional framework, which is—unfortunately—lacking in most countries in the region, and which is applicable to many aspects of the rural development strategy, not merely to environmental services. The discussion above has noted various ways in which public support for environmental services can be offered. The effectiveness of such public support depends on the extent to which governments can improve their information gathering and institutional capacity.

There are, however, other public policies that are usually not discussed under the environmental policy umbrella but which are nevertheless important in terms of their unintended environmental impacts. Of these policies that indirectly affect the environment, it is worth emphasizing three: (1) poverty reduction programs in marginal areas that are environmentally sensitive; (2) patterns of public expenditures and investment; and, (3) policy failures with respect to property rights.

Poverty reduction in marginal areas benefits the environment because the poor, particularly poor farmers, are often more dependent on the use of resources that are more susceptible to degradation. This is often the case with pressure on forested areas, including native forests; with the mining of the soil for short-run economic survival; and with the use of coastal fisheries when the capital for deep-sea fishing is unavailable. The classic case is the intensification of farming in hillside areas in the tropics, which usually leads to rapid soil degradation, unless significant soil protection investments are implemented. The poor are less mobile with fewer alternatives in production and consumption, drawing on the environmental capital of their immediate surroundings, and can hardly spare savings for on-farm investment (some of which are of long gestation). The poor very well may appreciate environmental services, but they often cannot afford to protect these assets. Those with higher income depend relatively less on extracting resources from fragile areas and can rely more on nonextractive activities. And in general, higher incomes and particularly higher education levels tend to be associated with less dependence on extraction and thus a higher relative evaluation of the benefits of maintaining the environmental capital.

The composition of public expenditures is not neutral with respect to the environment. Roads are an illustration of this. The impact of a more extensive road network, with penetration into new areas, is usually associated with greater deforestation. In contrast, the intensification of already-existing road networks impacts far less, or even not at all, the expansion of commercial activities into isolated forested areas. Governments should be aware that the pattern of public expenditures could be more pro-environment.

Tenure insecurity, pervasive among the rural poor, reduces incentives for longer-term investments, such as soil conservation measures (for example, agro-forestry and terracing). The absence of title registration inhibits land market development in poor areas, beyond informal and short-term tenancy arrangements. In addition, common property resources (grazing land, wood for fuel, water, fallow land) are important for the poor, particularly for indigenous communities. Communities with common property arrangements are often efficient in managing their natural resources in a sustainable manner. As population growth accelerates, traditional social arrangements, sometimes become difficult to maintain, leading to soil degradation and biomass losses.[16]

8.3 Rural tourism and public support

Rural tourism has become an important activity in rural areas in industrial countries, particularly in Europe. For example, countryside tourism in England was estimated to generate about £12 billion annually. For those living in rural areas, tourism has become an additional income source. The decline in farm production's ability to generate competitive incomes has induced many farmers to seek new income sources and to diversify their agricultural base.[17] In the United States, 30 states have tourism programs specifically targeted for rural areas; rural tourism was adopted as an important restructuring strategy in rural development polices. In addition to its role in supplementing rural households' income, the promotion of rural tourism is predicated on the importance of preserving rural areas, the landscape, its amenities, and social fabric.

For several countries in the Latin American and Caribbean region, tourism from all sources is also becoming a relatively large economic sector. As shown in table 8.3, tourism receipts from all categories represented close to 7 percent of GDP for Costa Rica, 10 percent for the Dominican Republic, and 18 percent for Jamaica. Furthermore, as a percentage of total export revenues, tourism is much higher. However, little is know about rural tourism in the region.

TABLE 8.3

Tourism sector size in eight Latin American and Caribbean countries

Country	Number of tourists, '000s	Revenues from tourists, $ billions	Total export of goods and services, $ billions	Revenues from tourism exports as % of exports	Tourism receipts as % of GDP
Bahamas	1,577	1.5	1.9	79.4	—
Costa Rica	1,032	1.0	8.1	12.3	6.6
Cuba	1,561	1.7	—	—	—
Dominican Republic	2,649	2.5	8.3	30.4	9.6
Guatemala	823	0.6	3.2	17.6	—
Jamaica	1,248	1.2	3.4	35.7	17.9
Mexico	19,043	7.2	146.8	4.9	—
Nicaragua	468	0.1	0.8	13.8	4.5

Sources: World Bank, *World Development Indicators 2001;* Sachs et al. 2002; and World Tourism Organisation.
Note: — Not available.

What defines rural tourism? An important feature of rural tourism in industrial countries has been the larger number of small, family-based business that are engaged in it. The study by Fleischer (2004) lists a number of characteristics that stress the location, scope, size, tradition, and integration of rural tourism enterprises into the rural way of life:

- Located in rural areas;
- Functionally rural: built on the rural world's special features of small-scale enterprise, open space, contact with nature and the natural world, heritage, and "traditional" societies and practices;
- Permits participation in the activities, traditions, and lifestyles of local people;
- Provides personalized contact;
- Rural in scale—both in terms of buildings and settlements—and therefore, usually small-scale;
- Traditional in character, growing slowly and organically, and connected with local families;
- Diverse, reflecting the idiosyncrasies of communities' economy, history, and location;
- Show a high percentage of tourism revenue benefiting the rural community.

In their survey on rural tourism in industrial countries, Hall and Jenkins (1998) conclude that tourism can make a potential contribution a region's development, prosperity, and tax base. One risk they note is the tendency to inflate the possible benefits to communities and underestimate planning requirements. The experience in industrial countries also suggests that an area's diversification into tourism is not possible for all communities, but (according to Wilson et al. 2001) requires several attributes:

- **Attractions:** the natural and manmade features both within and adjacent to the community;
- **Promotion:** marketing a community and its tourism attractions to potential visitors;
- **Infrastructure:** access facilities (roads, airports, trains, and buses), water and power services, parking, signs, and recreation facilities;
- **Services:** lodging, restaurants, and various retail businesses needed to take care of tourists needs;
- **Hospitality:** how both community residents and employees treat tourists in the tourism business and attractions.

In the context of Latin American and Caribbean rural areas, one should also add personal security conditions and the exchange rate regime as influential considerations.

There are several economic arguments that can be raised in favor of some degree of government support for rural tourism. Landscape and rural amenities are often cited as cases where public support would be warranted. Agricultural and forest land provide public amenities in the form of wildlife habitats, protection of natural resources, open spaces, esthetic scenery, and cultural preservation. Farmland's landscape value consists of the benefits derived from the scenic beauty generated by rural landscape, such as open fields, orchards, and livestock herds grazing in green meadows. Because such

amenities are of a public good nature, markets tend not to allocate resources to them, and some sort of policy intervention might be efficient (Fleischer and Tsur 2000). There is also an argument that tourism in remote areas would help sustain employment and economic activity in attractive regions that otherwise would deteriorate, if it were not for the income from richer tourists.[18]

The experience of the past 20 years in industrial countries has shown that tourism has promoted development in rural regions.[19] Today, tourism serves as an important economic base in many rural areas by complementing agriculture, but not necessarily replacing it. For example, Toscana and Provence are considered tourism-based regions, but most of the land is cultivated farmland, which is part of those regions' attraction. In Europe, rural tourism was adopted as an alternative policy instrument for the economic restructuring of rural areas. In Eastern Europe, where rural regions presently suffer from high unemployment levels, tourism has been emphasized as a possible engine to help these regions out of their economic and social slump.

But rural tourism is not a panacea. Fagenece (1998) reviews rural tourism case studies in Indonesia and Thailand. The conclusions from the Indonesian case studies were that the more attractive the region is to tourists, the higher the government's involvement and the loss of control by the local communities. In his work on tourism in hill tribes in northern Thailand, Cohen (1997) refers to the danger in tourism overpowering the village culture and lifestyle. Forsyth (1995) researched the adoption of tourism by agricultural communities in northern Thailand. He found that tourism was adopted only by those with available cash and labor and did not present a viable alternative to agriculture. Most of the poorest households did not have the resources to take advantage of it. His findings are related to those of Evans and Ilbery (1989) in their research of tourism adoption practices in England. In their study, the smaller and poorer farms capitalize on tourism less than the relatively large and prosperous farms.

More positively, there are the cases of Colombia coffee tourism (see box 8.3) and of Costa Rica. Costa Rica, in particular, is considered a Latin American and Caribbean ecotourism leader due to its political stability, relatively high degree of biodiversity concentrated in a small area, and a comprehensive system of public and private protected areas. The Ministry of Agriculture initiated the protected areas system in 1970 with the formation of National Parks Services (Rivinski 1991). The public system has been expanded by a growing number of privately protected spaces (the most famous one is the Monteverde reserve). Eco-tourism's economic revenues in Costa Rica might not appear very large by national standards, but their economic impact on local economies is very important.

Place (1988) evaluated the socioeconomic impact of Tortuguero National Park on the local community. He found that the local population's self-reliance on fishing and hunt-

BOX 8.3

Agricultural tourism in Colombia

The National Park of Agricultural Culture (PANACA) is an agriculture theme park located in Colombia's main coffee planting area (depressed by over a decade of low international coffee prices) in the Department of Quindio. Created in 1999 after a devastating earthquake in Armenia, the department's capital, using tax exemption for investing in the area, the park offers eight places to visit, including sites for livestock, chickens, parks, dogs, and horses, among others, in 103 hectares with 2.8 kilometers in pathways surrounded by bamboo forests and rivers.

The park enjoyed an instant success, with the number of visitors increasing from 250,000 in 2000 to over 300,000 visitors in 2003. Annual revenues surpass $4 million per year. About 220 people are employed directly in the park in low season and over 450 in high season. Visitors stay in nearby coffee farmhouses that have been converted to rural bed and breakfast hotels, adding to new employment and income generation in the area.

PANACA also offers commercialization space for farm associations and private firms in the agricultural, industrial, and financial sectors that can offer their services in different sections of the park. A large variety of agricultural products are sold commercially along with brand name PANACA products. The PANACA model is being franchised to other regions of the country, including a place near Bogotá, and internationally.

Source: Aliza Fleischer (Hebrew University).

ing has been replaced by a dependence on mainly part-time jobs generated by park visitors and other tourists. This transition from largely subsistence to a market economy had, however, already begun before the park was created, and small-scale, nature-based tourism has so far proved more benign than other modern economic alternatives that might have otherwise developed. The key appears to be the retention of this type of tourism within the contexts of a village-based delivery system that ensures the participation by the largest possible number of locals. Mass tourism businesses would call for outside investors and a large number of tourists, which dilute the local environment and culture.

Siegel and Alwang (2003) evaluated the impact of public investments in northeast Brazil on the local poor, finding similar experiences with those of Indonesia and Thailand. Public investments in physical infrastructure contributed to tourism growth, but have not necessarily improved the well-being of the poor. They concluded that there is a need for better targeting and planning of tourism investments. Improved human resources for the poor can enhance their participation in the economic growth resulting from tourism development.

Rural regions in developing countries seem to be even more fragile than those in industrial countries. The large socioeconomic and cultural gap between foreign tourists and local farmers calls for more cautious development. Thus, tourism incentive programs should take into consideration that the type of tourism being promoted should involve local participation and should not "erase" the unique natural, social, and cultural attractions upon which it is based.

Notes

1. Much of this section has been drawn from Castañeda (2004).
2. The 1996 FAIR Act was designed as a fixed, annual, lump-sum cash payment to farm operators based on previous production levels. Between 1996 and 2002, about $36 billion was paid to over 2.1 million farmers, giving an average annual payment of about $9,000 per recipient household and representing about 9 percent of net farm income. The 2002 Farm Bill was a retreat from decoupling, reintroducing, in addition to "emergency" payments (ostensibly to compensate farmers for a decline in commodity prices), a variety of "coupled" program elements: loan deficiency payments, the updating of base acres and payment yields as a basis of future payments, adding new crops to the payment basis, and paying "counter-cyclical" payments to support farmers through 2007.
3. For a discussion of the payment criteria under decoupled schemes, see Baffes and de Gorter (2003).
4. Cord-Wodon 2001; Sadoulet, de Janvry, and Davis 2001.
5. SAGARPA 2003.
6. Ibid.
7. See Lichtenberg 2002.
8. For a description of projects implemented in El Salvador and Mexico, see Pagiola and Ruthemberg (2002).
9. See Echevarria 2002.
10. Rojas and Aylward 2003.
11. See Pagiola 2002.
12. Rosa et al. 2003.
13. Pagiola 2002.
14. Rojas and Aylward (2003) conclude that, "To date, little effort has been made to monitor and evaluate the programme. The few studies that have been undertaken or are underway tend to focus on either traditional project monitoring or on examining the distributional implications of the programme. In other words, no study of the supposed intention, that is, an efficient and low-cost allocation of conservation monies, has been undertaken."
15. Rosa and others 2003.
16. See López and Valdes 2001 and Barbier 2001.
17. Commission of the European Communities 1992.
18. Asymmetric information could also be relevant in the case of rural tourism, considering that most rural tourist enterprises are small businesses, lacking access to the capital markets because they are unknown quantities, less accessible, and less visible to banks (Binks et al. 1992).
19. Fleischer 2004.

CHAPTER 9

Policy Challenges of the Spatial Approach: From Promise to Reality

9.1 Introduction

The large and diffuse set of policy issues on how the promise of the spatial approach can become reality is often presented in ways that defy formal evaluation. Consequently, this chapter focuses on policy frameworks that have been explored in various Latin American and Caribbean and other countries, with special emphasis on the roles played by various government levels and local communities. Indeed, the historical record of regional development programs (RDPs) is extensive, but our knowledge of which RDPs work is actually quite thin. Thus, whereas the evidence discussed in chapter 4 and previous work on interregional economic convergence suggests that the spatial approach is promising, the practical gap between the promise and the reality of this approach remains wide.

Policy interventions aiming to improve the development prospects of poor and often isolated rural areas either remain poorly understood or have failed in light of persistent territorial inequities because these policies face the challenge of coordinating the roles of various government levels. Moreover, this coordination among local and central (or federal) governments must also take place in the context of more active participation by local communities. In other words, RDPs are unlikely to succeed without the active participation of civil society and communities more generally, in defining local priorities for public investments. At the same time, local and national governments must balance local needs and interests with the national interest or regional interests that go beyond those identified by local communities. Another important reason why our knowledge of best practices remains weak is that historically, RDPs have not been properly evaluated, thus leaving behind bread crumbs rather than visible guiding lights for policy formulation. This chapter attempts to bring to light the spatial approach's twin challenges to maximize the rural contribution to development in Latin America and the Caribbean and beyond.

Section 9.2, below, addresses policy issues concerning the roles of various levels of government and local communities. In turn, section 9.3 discusses analytical challenges pertaining to the evaluation of RDPs. In conclusion, section 9.4 presents a hopeful message about the need to combine the traditional rural development sector approach with the more novel yet poorly understood spatial approach.

9.2 Government and community roles in enhancing the rural contribution to development

In this section, a number of issues will be raised as a way of focusing the debates about regional policy and to set the stage for the discussion of evaluation approaches in the next section. Some issues have been debated for decades (often without resolution), while others reflect a changing Latin America and the Caribbean and global context, especially international trade liberalization.

Multiplicity of objectives, intergovernmental coordination, and community-driven development

Regional policy is not some homogeneous "good"; the composition of this policy varies significantly from one country to another. At one extreme, U.S. federal regional policy is virtually nonexistent (for example, the U.S. Economic Development Administration, charged with attending to regional issues, has a budget that consumes 0.21 percent of the federal

budget). In other countries, regional development policy may be promoted by a variety of agencies and, in many cases, there may be little coordination between these agencies. With decentralization pressures, regional policy may end up looking more and more like the case of the United States, with the states (or provinces) in a country assuming this role.

The coordination problem is an important issue—one agency may be concerned with infrastructure development, another with investment in human capital, and a third might be involved with industrial attraction—but unless there is some coordination, the process may prove to be ineffective. Federal-level agencies may have different objectives than those at the regional, state, or local levels. The result can often produce conflicting strategies and poor-quality public services. For example, subnational government units, bristling under a federal overseer's influence, may move policies in entirely different directions as a result of decentralization and may resist any attempt to coordinate policies and investment strategies among neighbors.

This latter issue brings to the fore another major issue with regional development—the degree to which the process is consistent across national, state, and local levels. Recent theoretical and empirical studies have focused on the national gains of detailed geographic targeting of poverty-focused fiscal transfers across lower-level jurisdictions (Ravallion 1993; Elbers et al. 2004). The consensus seems to be that national well-being is best served when only a subset of jurisdictions receives such transfers, when there is low labor and capital migration. Yet differential treatment of local jurisdictions can also lead to labor and capital migration to areas that are targeted by the benefits. In other words, differential treatment of jurisdictions can create distortions in the form of incentives for people and money to move to areas where the transfer—the carrot—is highest or where the tax burden—the stick—is lowest (Fujii and Jack 2004). Three types of instruments have been used to foster Latin American and Caribbean regional development. The most important one is possibly fiscal federalism entailing federal transfers to state or local governments; the others are sectoral and regional promotion policies. An extensive analysis of the regional consequences of fiscal federalism and the decentralization of social expenditures is beyond this report's scope, but De Ferranti and others (2000) previously examined these issues.

Carrot versus stick policies and the race to the bottom: country experiences[1]

An important source of major discussion in past decades has been the role of enticements to attract firms to less attractive locations, versus legal development limitations in more prosperous areas. Canada enacted policies in the 1960s and 1970s that focused on regions with a significant portion of the labor force (>30 percent). While there is no percentage of the country that should be covered by regional development policies, critics felt that the lack of spatial focus undermined any policy. Further, the policy was heavily focused on incentives to attract firms to specific regions; the less prosperous the region (for example, Canada's Atlantic provinces), the higher the incentives. These incentives were of two kinds: the first addressed modernization or expansion, while the second set provided contributions for a new plant or product expansion.

In Britain, a combination of incentives (carrots) and restrictions (sticks) were employed. Firms were actively discouraged from locating in London and southeast England in general and provided incentives to locate in northwest or northeast England. The latter areas have proven to be very unpopular, and most regional development policies of the current period focus heavily on incentives.

Argentina has a similar historical experience with regional incentives. With devolution of power away from national or federal governments, regional policy has often degenerated into fiscal wars, with states vying with each other to lure a small number of large establishments. In most cases, no formal project appraisal was conducted to promote the wisdom of the incentive programs.

Regional and industrial promotional regimes that provide tax exemptions and investment incentives oriented to promote different regions and economic sectors have received less attention. Porto (1991) analyzed the local effect of several programs in Argentina, but such studies are rare and are usually done ex post and not as part of government policy evaluation. However, there is some evidence that promotional regimes had some impact in several Argentine provinces, mainly San Luis and Tierra del Fuego. The econometric evidence presented in chapter 5 is thus a modest contribution to understanding how such tax incentives have affected employment generation across Argentine provinces.

The regional promotion regime (not industrial) was introduced in 1979 for agriculture, cattle, and tourism sectors in La Rioja. In 1982, it was extended to Catamarca and San Luis, and it has benefited San Juan since 1983. During 1995 and 1996, the federal government included Mendoza, Santiago del Estero, Formosa, Salta, Jujuy, Tucumàn, Chaco, Misiones, and Córdoba. The regime's general objec-

tives were to promote industrial investment in laggard regions to improve income distribution across regions. The industrial incentives have had different changes since their introduction in the 1970s. In fact, apart from the regions included in the industrial promotion regime, some other regions also received subsidies through the Secretaría de Industria.

Special incentives targeted Tierra del Fuego.[2] This region was a tax-free zone until 1972. After that year, several schemes were used to promote industrial employment in the region. In fact, the regime can be defined as a mixture between an industrial promotional regime and a tax-free zone, involving not only tax, but also duty exemptions. The regime consists of exemption of any national tax on acts, operations, or goods located on the island, VAT tax for sales and purchases inside and outside the island, and an exemption on income tax and import duties (total exemptions for locally important industries). In addition, there is an export differential treatment, not only for exports to other provinces, but also for exports outside the country. In that case, the local special treatment includes Patagonia's port incentive plus an extra 10 percent of reimbursement. Local authorities and not the industrial secretary operate the regime, which makes it more flexible. Nevetheless, national organizations such as Customs and the *Dirección Nacional de Impuestos* (DGI, National Directorate for Taxes) have to perform a preliminary control (in a 60-day period), and there is no fiscal limit provision. The promotional incentives apply only to already-operating industries and products that are not produced internally. The regime expires on December 31, 2013.

This special regime generated industrial and commercial activity in the region. In fact, gross production value increased by 1,200 percent in U.S. dollars between 1973 and 1987, and employment increased by 1,100 percent. Industries such as electronics, appliances, textiles, and plastics have shown an impressive increase in the area. However, Salinardi (1991) estimated industrial promotion's fiscal cost in Tierra del Fuego at $50,000 per employee per year. Most of the firms relocated from the Buenos Aires metropolitan area and are actually operating as assembly and not manufacturing firms. The study shows that foreign input participation in the regional output is above the national average, and the value added in the local economy is below the national average. Indeed, the promotional regime failed to generate a supportive network of local providers. In 2002, the amount of tax exemptions was estimated to be over $500 million.

In the original regime, the promoted sectors included the petrochemical, steel, and wood industries. This regime expired in 1977 and was replaced by another that included electronic and petrochemical industries together with a wider array of provinces. In 1989, because of fiscal crisis, the promotional regime was partially revoked. In fact, there will be no further benefits for additional projects, but for those still working, the promotional regime continued every year. This situation generated a complicated network of regional and sectoral fiscal incentives that overlap in additive form with a fiscal impact and social effectiveness that can hardly be estimated and measured.

Other promotional regimes include export promotion regimes. Regulated by law 23101/84, the benefits (Lattes, Rodriguez, and Villa 2002) include fiscal incentives and duty exemptions. Among the fiscal incentives, the Patagonia (exports through Patagonian ports) and north regions (exports from Salta, Tucumán, and Jujuy) receive some especial tax exemptions. Among the duties exemptions, Tierra del Fuego receives special treatment.

Promotional regional regimes also involve promoting regionally-concentrated industries, such as wine producers in Mendoza and San Juan. This regime established investment deductions against national taxes. A further regime established additional benefits (income tax deductions) to facilitate vertical integration and diversification in origin, generating incentives to relocate firms from metropolitan areas. Another instrument that was widely used in the 1980s was the state-owned winery to control prices and regulate the market (privatized in 1993). Finally, fiscal exemptions to foster marginal land incorporation had an important impact on regional economies. Besides Mendoza and San Juan, this regime benefited other provinces such as Rio Negro, La Rioja, Neuquen, Catamarca, Salta, and Jujuy.

The special regime for tobacco introduced in 1972 benefits mainly Salta, Jujuy, Tucumán, Misiones, and Corrientes, and also Catamarca, Chaco, and Santa Fe. Its purpose was to support tobacco industries in the north of Argentina. It subsidizes tobacco production by establishing a special tobacco fund that is generated from cigarette sales taxes. The regime establishes a minimum price for tobacco gathering and a transfer to the producer. This procedure allows for a low price for tobacco exports and, at the same time, considers the social situation of local producers who

benefit from the transfer. The regime generated a sharp increase in production and productivity of about 38 percent during the 1980s. Indeed, the price received by producers increased by 92.9 percent in the same period, while the gathering price increased by only 27 percent. Thus, the improvement for producers is mainly due to the regime. By Law 25465/01, Congress excluded the tobacco sector from the national deregulation program.

Another promotional regime addressed the sugar sector, including incentives to generate sugar alcoholic-gas for car propulsion. Law 19597 regulated the sugar industry, under the Dirección Nacional del Azúcar's (DNA) authority. The DNA established the production quota and prices, regulating all the aspects of sugar activities including production and commercialization. As international and local sugar demand decreased (due to the increasing use of sugar substitutes), the pressures for more regulation increased, especially from the producers' provinces. However, the sugar sector has been completely deregulated since 1998, including production and commercialization. This deregulation generated an asymmetry in relations with Brazil. The Proalcohol program subsidizes Brazilian sugar production that is used as a substitute for petroleum imports. This topic is an important one in the MERCOSUR agenda.

In 2001, the federal government established the so-called "Competitiveness Plans" together with promotional incentives to promote national production of capital goods, computers, and telecommunication. The plans included income tax exemptions and provisional and VAT exemptions involving several economic sectors, including services such as transportation firms. Other special regimes extended the exemptions to capital goods and car suppliers and R&D technological industries (Decree 379/01).

Some of the above-mentioned programs were partially cancelled in 2002 due to the Economic Emergency Law. However, for 2002 the overall tax expense due to promotional regimes was estimated to be over $1.9 billion, including the Tierra del Fuego promotional regime ($500 million), Competitiveness Plans ($465 million), and industrial promotion ($319 million).

Provincial governments also offer special incentives, including provincial and municipal tax exemptions for corporations. Some provinces also provide special financing programs, reductions to local service tariffs, and access to subsidized loans. In most cases, provinces have industrial areas with special industrial infrastructure, and most of them have tax-free zones. In general, provincial promotional regimes have the objective of promoting economic sectors with relative local advantages (for example, natural resources, tourism, or strategic locations) and promoting locations in relatively lagged regions. Table 9.1, below, summarizes the different regimes in the provinces. The generalized use of tax exemptions by the provinces should be noted. In fact, the use of tax exemptions may be related to lack of fiscal correspondence, especially in the provinces that have benefited from positive fiscal transfers.

The lack of regional studies on these programs' effects makes it difficult to argue that such incentive schemes have worked or failed. The evidence discussed in chapter 4, which Sanguinetti and Volpe (2004) produced, provides a welcome, but still insufficient assessment of the welfare effects of promotional schemes. However, it is clear from the long history of Argentina's promotional schemes that the chosen instrument for promoting regional development in this country has always been tax incentives or subsidies, or some combination of both.

Likewise, EPZs and other fiscal incentives, such as wage subsidies and sales subsidies, have been important components of Chile's overall policy towards its so-called "Extreme Zones" (*Zonas Extremas* or ZEs). These fiscal incentives were complemented by raising the allocation of public investments in the target regions, including the provision of public housing. These regions (mainly regions I, XI, and XII in Chile's regional coding) continue to be considered of geostrategic importance for Chile; they are located in the extreme north and south of the country, in areas that have been characterized by border disputes with their neighbors. A recent study by Rojas et al. (2004) shows that the fiscal costs of Chile's EPZ benefits, including forgone tax revenues plus public subsidies and expenditures, was over $420 million in 2001 alone. This number implies a total cost per capita in the ZEs that exceeds $630 in that year. This implies that such expenditures exceed 10 percent of the average income of the national population, and thus these are not trivial fiscal costs, whereas the effects of these policies have not yet been properly evaluated. It is quite likely that the fiscal costs of tax incentives and subsidies in other countries, including Argentina, that aim to help regional development are also quite high, and they remain unevaluated. Furthermore, carrots and sticks can also be used to promote certain industries in poor regions, which central planners believe can spur territorial development and localized poverty reduction. This is the topic of the following section.

TABLE 9.1

Provincial regional policies in Argentina

Province	Promotional law	Exemptions	Other	Free tax zone	Industrial areas
La Rioja	Promotional regime	Provincial and municipal taxes	Fiscal Stability Law		4
Catamarca	Promotional regime	Provincial taxes	Tourism		
Tucumán	Tax exemptions	Provincial taxes	Industrial law		
Misiones	Industrial promotion	Provincial taxes	Mining Forest	Puerto Iguazu	4
San Juan	Industrial promotion	Provincial taxes Credit Electric tariff			1
Neuquen	Promotional regime	Provincial taxes Credit Business support Fiscal lands	Reimbursement Patagonia's ports		6
Rio Negro	Industrial promotion	Provincial taxes Business support Fiscal lands	Reimbursement Patagonia's ports	Sierra Grande	7
Salta	Tax exemption	Provincial taxes Tariff reductions	Local financing	Guemes	3
Santa Cruz	Promotional regimes	Provincial taxes Local financing Tariff reductions Technical support	Reimbursement Patagonia's ports		
Santa Fe	Promotional regimes	Provincial taxes Fiscal land			6
Santiago del Estero	Tax exemptions	Provincial and municipal taxes		Frías	1
Chaco	Industrial promotion	Provincial taxes Investment reimbursement Tariff reductions Fiscal lands	Forest	Chaco	4
Chubut	Industrial promotion	Provincial taxes	Forest Reimbursement Patagonia's ports	Comodoro Rivadavia	13
Ciudad de Buenos Aires	Tax exemptions	Local taxes	Providers and south-located industries		
Cordoba	Industrial promotion	Provincial tax	Tourism	Cordoba (Zofracor) Juarez Celman	4
Corrientes	Industrial promotion Provincial exemptions	Provincial taxes Tariff reductions		Paso de los Libres	1
Entre Rios	Industrial promotion	Provincial taxes	Financing	Concepción del Uruguay	7
Formosa	Industrial promotion	Provincial taxes Fiscal lands Government warranties		Clorinda	1
Jujuy	Tax exemptions	Provincial taxes	Financing	Pericó	6
La Pampa	Tax exemptions	Provincial taxes Technical support	Financing	General Pico	2
Buenos Aires	Promotional regimes	Provincial taxes Provincial warranties (FOGABA)		La Plata	14

Source: Elosegui 2003.

From old "key" sectors to new key sectors and economic poles

There might be no better example of experimentation with the "key" sectors and economic "poles" approaches than Brazil's historical experience. The Superintendency for the Development of the Northeast (SUDENE) was created in 1959. Its initial activities were based on a document named "Grupo de Trabalho para o Desenvolvimento do Nordeste" (GTDN) that Celso Furtado elaborated. This document's main message was to stimulate the region's industrialization process to replace the "old" agricultural export-led model (Bacellar 1995). According to Baer (1995), the outcomes of SUDENE's developmental plans were disappointing. However, during 1962–89 more than 2,700 projects benefited from the incentives system that SUDENE managed and generated 500,000 new jobs. The investments for these projects were around $47.1 billion, with only $16.4 billion financed by federal fiscal incentives. But the social consequences of such spending were not clear.

In the early 1970s there were direct government actions in other lagging regions as well; the National Integration Plan (PIN) was created to develop the Amazon region, PROTERRA was established to modernize the agricultural sector, and PROVALE was founded to accelerate agricultural development in the empty areas of São Francisco River borders. Baer (1995, 294) points out that just a few of those actions were completed by the mid-1970s.

Other regional policies implemented during the 1970s and early 1980s in Brazil include: economic and social infrastructure investments, fiscal incentives that allowed firms to use their income taxes in specific investments projects, and public firms' ability to obtain loans to invest in the country's least developed regions. These instruments were applied under the economic poles approach under the National Development Plan of 1975–79, which emphasized "the creation of various 'development poles' for backward regions" (Baer 1995, 295). Some examples of these poles were: (a) in Pernambuco state, Petrolina-Juazeiro, where irrigation processes were implemented to create an agro-industrial complex; (b) in Bahia, Maranhão, and Piauí states, in the cerrado areas, where grains, mainly soybeans, were cultivated using new technology to adapt plants to the dry weather; and (c) in Bahia state, Camaçari, where a petrochemical pole was established with help from PETROBRAS. Also during the late 1970s, three dynamic areas were created in the north region and benefited from publicly provided subsidies and tax incentives: (a) the western agricultural pole in Rondônia state; (b) the Zona Franca de Manaus, a tax-free industrial area; and (c) in Pará state, the mining-metal complex of Carajás.

The northeast's relative development improved during 1975–85, when the combined GDP of Brazil's north, northeast, and central-west regions increased from 17.2 percent to over 25 percent of the nation's total GDP (Haddad 2003). These changes could be interpreted in terms of Richardson's (1969) notion of "polarization reversal," defined as "the turning point when spatial polarization trends in the national economy give way to a process of spatial dispersion out of the core region into other regions of the system." It is arguable that the fundamental sources of Brazil's polarization reversal that began after 1975 include: (a) the fact that the São Paulo metropolitan area suffered from congestion-related costs, including high land prices, rents, infrastructure costs, and upward pressures on labor costs; (b) social and economic infrastructure expansion in other states and regions (other than São Paulo) that stimulated growth in other areas; (c) expansion of the agricultural and mineral frontiers towards the center west; and (d) market integration because of improvements in transportation networks across the country (Haddad 2003). Thus public policies were but one of numerous potential explanations of the modest rise of the GDP share of Brazil's laggard regions during the late 1970s and early 1980s.

In the early 1990s, two policies—Politíca Industrial e de Comerció Exterior and Política de Competitividade Industrial—aimed to complement the increasing trade liberalization that was being implemented at the time. A key ingredient was the incentives to expand the agricultural frontier towards the center-west region. The plan's success continues, as Brazil is expected to become one of the world's largest producer of soybeans in the near future. However, this brief historical review of Brazil's regional development policies reveals two constant characteristics, namely, a knack for focusing on the nexus between key sectors and regions, coupled with an apparent lack of formal evaluations of such programs. The regional and national welfare effects of these experiences therefore remain murky. What is clear is that the central government's agencies are the only institutions with the responsibility for promoting national welfare. As with the other approaches, Latin American and Caribbean countries have extensive policy experiences addressing the crucial role of central governments.

The central government's role in regional development programs[3]

Although the central governments of most Latin American and Caribbean countries have played important roles in the

RDPs' implementation and design, Mexico's experience is particularly relevant, due to a historical legacy that formally mandates that the central government play a coordination role. In fact, regional development planning in Mexico dates back to 1947 when the Papaloapan and the Tepalcatepec River Commission started work on three hydrological basins. To date, each new administration is compelled by law to present six-year regional plans. Despite this history, there is an apparent consensus among academics and international agencies that economic and social policies lack a regional perspective (for example, Aguilar 1991; Martínez and Domínguez 1991; OECD 1998).

The National Development Plans of the past three administrations included a (short) chapter referring to regional development, and all commented on the necessity to decentralize the urban system but offered no specific targets or measures. Apart from these initiatives, each administration has also prepared urban development programs to implement the urban aspects of the corresponding National Development Plans (Garza 2003). Those are: National Urban Development Program 1990–1994 (Programa Nacional Urbano 1990–1994); 100 Cities Programme-1994 (Programa de 100 Ciudades-1994); Urban Development National Program 1995–2000 (Programa Nacional Urbano 1995–2000); and Urban Development and Territorial Redevelopment National Program 2001–2006 (Programa Nacional Urbano y Ordenación del Territorio 2001–2006). Similar to earlier urban plans, these do not show any clear theoretical or conceptual discussion, a clear and measurable diagnostic or targets, or any discussion of specific measure to reach their goals. However, they all mention an urban system that needs reform and decentralization; therefore, they suggest the formation of interconnected urban subsystems around the three largest metropolises; such subsystems should also distribute services along the set of towns. The two most recent plans also stress the need to reach sustainable urban models through a careful management of natural resources, the environment, and waste. Another stated objective has been the maintenance of territorial reserves for future expansion (OECD 2003). The 100 Cities Programme-1994 corresponds to the National Development Plan 1990–1994. It includes aspects of developing the local abilities to regulate growth in 116 cities (out of a total 304 that made up the national urban system in 1990) as well as some social development issues.

The Puebla-Panama Plan, Mexico Chapter, intends to remove structural obstacles to growth in the southern region, but also to promote the integration of these states into Central America (OECD 2003). Apparently however, no Central American country has produced any other corresponding plan. The strategy includes alleviating poverty, promoting private investment and environmental sustainability, and constructing basic infrastructure and new public policies regarding prices and tariffs of goods and services. Instead of explaining how the objectives are going to be achieved, Garza (2003) points out that the plan only describes the goals in further detail.

The Microregion Program is, in fact, a tool to address rural poverty in the poorest municipalities from a local perspective. The strategy concentrates and coordinates every possible program that can be channeled to these municipalities and focuses them through community centers, which the target population should reach easily. In 2002, there were 263 such microregions comprising 1,334 municipalities in 17 states, about 20 percent of the total population (OECD 2003). As basically a territorial assistance program, it seems to be fulfilling its main target, that is, making the life conditions of millions a bit easier.

The Office of the President is responsible for strategic planning for regional development. A recent paper states that overcoming the differences between regions is a top priority for the government (Presidencia de la República 2003). To this end, it has created a "planning system," including state and federal agencies that will take actions, if independently decided, that should be carefully coordinated under the National Development Plan umbrella.

Under the regional planning model, the paper encourages discussion among actors in each region so that eventually a flexible planning model will be reached, one that should include mechanisms of regional management and a regional planning process. The former is expected to bring together the interests of the federal government, those of the states included in each region, civil society, and the private sector. The character of institutions to be created is carefully described; the regional planning process expects that each municipality and each state in the region would produce a development plan. These plans would be coordinated at this instance according to a diagnostic evaluation of an individual region's needs, from which a strategy should be designed, together with a regional development program. The latter, in turn, includes a portfolio of projects. Finally, a number of performance indicators would be gathered to relate the initial proposals with the results. A regional fund would finance this process; transfers from the federal government, the states included in each region,

civil society, and the production sector would form the fund. In any case, it is clear that Mexico's historical focus on planning systems for coordinating investments in public goods is promising, especially if it is combined in the future with formal impact evaluations of such investments.

Thus far we have highlighted the threat to national development that can emerge from a race-to-the-bottom by lower government levels when they have the authority to provide either carrots or sticks without the central government's active role in limiting such incentives to only a few well-targeted regions or populations. Likewise, even well-intentioned public investments driven solely by official governments, either local or national, can have unsatisfactory results when policy makers do not fully understand the needs of local communities. While this concern can be ameliorated with the advent of democracy and local elections, political marginalization of rural communities can persist, thus potentially hampering the social benefits of public investments. Thus the efforts of local and central governments must be accompanied by active participation of local communities and civil society in both the identification of needed public services and in the way the investments are undertaken.

Community-driven rural development

Development agencies have a long and rich history of operations directed toward community-driven development (CDD), beginning with a Northeast Brazil Rural Development Program (NRDP) pilot in the late 1980s. Over the 1993–2004 period, aggregate World Bank lending to Latin American and Caribbean countries for CDD-related operations totaled $3.3 billion. More than one-half of all CDD operations are in the rural sector. In addition, about two-thirds of currently active CDD operations in the region are found in three middle-income countries: Brazil, Colombia, and Mexico. Today, community-based organizations in countries such as Bolivia, (Northeast) Brazil, Ecuador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, and Peru play a major role in (a) identifying local investment demands; (b) channeling these demands to municipal and state-level governance structures; (c) delivering public services; (d) directly managing financial resources and procurement; and (e) supervising and monitoring the implementation of these services.

To be successful, CDD operations must be grounded in the *community-empowerment principle,* which, according to anecdotal evidence, is effective both in terms of process and product, *when it is allowed to work.* CDD cannot only improve project targeting to beneficiary groups (typically through self-selection), but also can more cost effectively deploy resources in expressed local priorities. Furthermore, CDD can build *human and social capital,* instill a *sense of ownership* on the part of beneficiary communities, and facilitate maintenance of chosen investments, thereby improving their *sustainability.*

Nonetheless, problems can occur when the political support for CDD interventions is missing, which can be the case when national officials are reluctant or nervous about granting true decision-making authority to the local level. Where CDD allegedly has been successful, central or state governments, often supported by donors such as the World Bank, have been willing to provide the crucial *enabling environment,* by both exercising the political will to experiment with CDD specifically—as a key element toward greater decentralization—and promoting stronger local institutional structures, especially at the municipal level. While local responsibility is promoted, fair and transparent "rules of the game" are put into place, which local communities accept and apply in a consistent fashion. Under these conditions, CDD can strengthen local governance and make the delivery of productive projects, small infrastructure, and services more effective, when compared with more traditional forms of service delivery.

Moreover, successful CDD programs can contribute to a new "institutionality" emerging in the region, around the concept of increased participation of local actors, including farmers' organizations, civil society, local governments, and the private sector. A "rural space" approach is the vehicle for achieving local-level integration and contributing to a broad-based regional development agenda. Increasingly, roles are being transformed, with "beneficiaries" becoming "clients," taking leadership of regional planning and priority-setting, guiding and negotiating local development processes, and otherwise creating the conditions for greater accountability and better governance. Acknowledging the advantages and development results that CDD affords, governments are increasingly leveraging community organizations and municipal governance structures created under CDD operations to channel and prioritize other investment resources, further scaling-up the impact of CDD operations, and helping to ensure the long-term viability of these institutions in reducing rural poverty.

Nonetheless, CDD also poses some challenges. One was already discussed in this chapter. It has to do with fact that

it is difficult for local communities to understand the needs of other regions and communities. Since many public investment projects, especially in infrastructure (see chapter 7), entail investments that reduce communications and transport costs across communities, CDD mechanisms must be balanced with the broader regional or national interests. Finally, while we have received substantial positive feedback regarding the CDD approach's effectiveness and popularity, there is still much work to be done in terms of more formal evaluations of CDD projects, as discussed below. In the meantime, while CDD is becoming popular for delivering targeted public services to local communities, the dynamics of territorial development are currently taking place in the context of global phenomena that will undoubtedly continue to change the economic fabric that affects the development prospects at the local level.

Regional development under free trade areas (such as the EU and NAFTA)

The previous discussion viewed regional policies as emanating from a nation down to some smaller geographic unit. The development of trading blocks, such as the EU and NAFTA, now provides a further level in the hierarchy. Coordination between countries creates an additional step, but regional policy instruments were proposed as one of the main reasons for the EU's formation; in contrast, the issue was barely addressed in NAFTA's creation.

The problem that is now created involves the degree to which regional (interventionist) policies can be seen to be consistent with the WTO tenets. Countries such as Italy, Portugal, and Spain, with strong regional development problems, would find it difficult to subscribe to the notion that no intervention be made in their less prosperous regions, so that the full benefits of WTO liberalization could be realized. Of course, this sets up a tension between the more developed and the less developed regions, with the former likely to gain appreciably from free trade (see the Brazil experience documented in the next section and the Lederman, Maloney, and Servén NAFTA study [2005]).

Trade liberalization and regional development: Link with the new trade theory and the new economic geography

Perhaps the starkest contrast in the regional policy changes of the last decade and those of the preceding 40 years may be seen in the way in which regional policy was promoted. As noted earlier, the equity-efficiency issue dominated debate, and even subsequent policies viewed the context as decidedly national in scope. Subsequently, the emergence of GATT and WTO has radically altered the spatial context. Regions in countries often have very different ties with different parts of the world; consequently, trade enhancement may help some and hurt others—even in the same country.

Furthermore, these developments have come at a time when many countries have had little or no information about regional import and export activity, in contrast to the plethora of national-level statistics. As a result, many benefits were ascribed to trade liberalization that did not materialize. For example, the United States-Canada Free Trade Agreement (a precursor to NAFTA) had little impact on Midwest states, since over 70 percent of trade with Canada was already free of tariffs prior to the agreement and most of the Midwest states' trade with Canada fell into these categories.[4]

What the new trade theory suggests is that processes such as vertical specialization are unlikely to result in the creation of significant clustering as trade costs fall, enabling firms to seek inputs from a broader geographical base and to supply markets that are much more spatially extensive than 30 years ago. The development of trade blocs further complicates the picture as location optimization now includes consideration of multinational inputs and markets. Further, competitive advantage has shifted from traditional concerns with labor costs (a dominant factor in the 1970s and 1980s) to concerns about labor quality and availability. Product cycle development that saw a product move from the R&D phase in the metropolitan United States to the southeast for mass production was soon transformed as mass production moved offshore. The maquiladoras of Mexico offered significant advantages, enhanced by the creation of NAFTA, only to be challenged in recent years by China, for example (see López-Cordova 2004). However, as mentioned in chapter 2, the attraction of metropolitan regions remains strong, leading to the possibility of a world economy with rich metropolitan regions contrasting with poorer, mainly rural regions, unless agriculture plays an important role in raising regional wages, as was the case in Brazil, but not in Mexico (see chapter 4). But even in the latter case, the evidence in chapter 5 suggests that the trade reforms period was associated with economic deconcentration across states, even if metropolitan areas in states might still be economic poles.

There are few cases where regional policy has been promoted to achieve gains from trade; the idea here is that with welfare disparities across regions, interregional trade

would be lower than would be the case if welfare levels were both higher and more even, under the assumption that trade occurs more readily among equal partners than among regions with vastly different factor endowments. Obviously, concerns about trade creation versus trade diversion occur, but most theorists would probably suggest that there would be welfare gains from the improvement in the position of less prosperous regions. However, the issue hinges on whether intervention can be justified to promote the welfare in less prosperous regions and the opportunity cost of funds diverted from other programs and uses.[5]

Firm ownership, multiregional, and multinational enterprises

A complicating factor in regional policy development of late has been the enormous growth in multiestablishment firms, especially those owning plants in several regions and/or countries. Firms are now seeking to optimize what is, in many cases, a vertically integrated commodity chain that may involve components from several regions and countries. In this context, regional development policy focusing on, for example, cluster analysis, will be challenged by the scale and scope of economies enjoyed by these enterprises; spatial proximity may not be the major consideration, especially if production costs in another country for a component yield a significant cost advantage.

The EU case: Reconsidering the management of structural policies

With regards to managing the funds, the "1996 Annual Report of the European Court of Auditors" made obvious the lack of transparency, efficiency, and control in the way that EU community aid is used. The Trousset Report in 1998 noted also that the monitoring committee's controls were not used frequently enough and all the regions were not equally handled. In fact, the validation of projects may appear excessively centralized. In some member states, there were serious delays in undertaking programs managed at the regional level as compared with those managed centrally, necessitating significant budget reallocations. In this regard, member states have not made sufficient use of the technical assistance that should have accompanied decentralization and enabled some of the problems encountered to be resolved. There was little participation of the social partners in program planning and monitoring. They complained about not being well represented on monitoring committees and not being kept fully informed of developments, although they cofinance the projects. However, they do not always perceive the general dynamics of policies at work, because they put forward their own region's objectives first, and these may not necessarily be consistent with those of the European Commission. Where programs are jointly managed, responsibilities in the organization of tasks need to be defined in a more efficient and transparent way.

Moreover, the GDP per capita is not the only criterion that is examined before sharing structural funds. Fayolle and Lecuyer (2000) underline that institutional bargaining is frequent and affects the way funds are shared. Finally, as regional or national cofinancing must accompany structural funds dedicated to particular projects (this is the "additionality" principle that reduces the temptation of regions to present nonviable projects, as they have to finance a part of the total costs[6]), it turns out that cofinancing doubles European aid in poor regions, whereas it triples or quadruples funds in regions with medium- or high-income levels, as they are better able to provide cofinancing. As cofinancing is adopted for all regions, one can also add that a region that has already attracted numerous firms enjoys higher tax revenues, and these additional revenue sources allow it to sustain continued development initiatives more easily. Higher public expenses may then attract more firms and foster industry concentration again. Until now, the European Commission has adopted no measure to reduce this "anti-redistributive" bias, but one could imagine that structural funds might be allocated under the constraint that national governments reduce regional divergence inside their country through additional funds. It would also be reasonable to consider more effective partnerships and the externalities among regions through a more integrated regional policy. This bias could however be justified by the fact that structural funds granted to medium-income regions may be favorable to the whole country's growth, even of poor regions, whereas helping the poor regions directly may reduce regional income inequalities, but may profit mainly the poor regions.

The EU case: Lack of labor mobility

Low labor mobility, due to linguistic and cultural barriers, is equally a factor that does not favor reduction in spatial equalities in income in Europe. Only about 1.5 percent of European inhabitants live in a country different from their country of birth, a strong contrast with the interstate mobility in the United States. However, the lack of international labor mobility may be protecting the economic advantage of lower real wages in southern countries, possi-

bly at the economic expense of its residents who could benefit from migration. International labor mobility could reduce the extent of wage differentials and increase concentration in and market size of the core (see Krugman and Venables 1996). However, the lack of labor mobility also is found in countries, and this may prove to be just as much a handicap in smoothing regional income inequalities. In Europe, the wage structures that characterize the labor markets are more rigid in each country than between countries, due to laws that prevent wage differentials in a single sector at the national level. Therefore, if wage differentials do not reflect a region's economic standing, then unemployment rate differentials do (Puga 1999). Moreover, a high national unemployment rate that reduces the probability of finding a job and unemployment insurance payments does not provide enough incentive to move outside one's own region.

An improvement in the job-matching process and other policies facilitating interregional labor mobility (decrease in costs of housing transactions or in difficulties of finding a rented accommodation) may allow reductions in the differentials in unemployment rates in a single country. For instance, Martin and Ottaviano (1999) notice that the job-matching process is more efficient where firms are agglomerated, and McCormick (1997) discusses how housing prices rise in faster-growing regions, a factor that may contribute to the persistence of low labor mobility across regions. Tax policies may also play a role (see Anderson and Forslid 1999; Madiès and Paty 2000), affecting factor mobility and hence firm and factor location decisions. This, of course, has been recognized in the recent political debate on tax harmonization. Ludema and Wooton (1998) show that with footloose industries, countries may be less willing to tax mobile factors of production at the expense of immobile factors (immobile workers). Such general equilibrium and political economy studies of the interaction between location choice and intensity of tax competition are vital to a full understanding of the EU's future industry geography.

9.3 Policy evaluation

Does regional policy work? This is an enormously difficult question to answer, especially given the problem, as Armstrong and Taylor (2000) point out, that it has often been difficult to quantify what regional policy is expected to achieve. Further, should the evaluation be ex ante or ex post, and should monitoring be a prominent feature of this evaluation process? The latter is important because circumstances change (for example, recessions occur, segments of activity decline in importance, and so on), and there needs to be some mechanism to provide the option to change course in midstream.

Definition of the region and data availability

While appearing to be a minor problem, regional definition is not something that can be dismissed. Identification of regions has been based on a variety of factors—physical geography (such as river basins), political jurisdictions (states, counties), and environmental considerations (air quality). Other approaches, such as the U.S. Bureau of Economic Analysis functional regions, attempt to exploit the idea of a region in the context of daily interactions (journey-to-work) patterns. With new developments in geographical information techniques, this problem will become less critical as more and more published data are geo-coded. Yet even if data are precisely geo-coded in household surveys, the latter rarely cover enough households in each village to make a representative sample for any particular community, although they are designed to be representative of the national population or, at best, a country's subregions (for example, the ENRUHM survey for Mexican rural communities discussed in chapter 2 provides representative samples for only a handful of subnational regions).

Recent advances in statistical techniques (Elbers, Lanjouw, and Lanjouw 2003) now allow policy makers and analysts to combine the data from a national census (which have a representation level that is much more disaggregated than household surveys) and from household surveys (which contain reasonable measures of income and consumption patterns in households) to develop detailed poverty maps that transcend the official jurisdictional boundaries of the various levels of government (municipalities, states, and so on). The authors, for example, were able to map poverty levels for settlements with populations as low as 15,000 persons in Ecuador. But this cannot be done for all social- and especially not for policy-related variables, unless either the census or the household surveys contain detailed geo-coded information about factors that can affect poverty and other social outcomes at the community or village level.

The regional unit problem presents the analyst with interpretation problems. Recent work by Nazara (2003) for Indonesia and Rey (2001) for the United States found that measures of unconditional convergence were sensitive to regional specification. But if any type of econometric or time-series analysis is to be performed, then one is often left with little alternative but to use official jurisdictional regions. The tough question is whether policy recommendations derived from these analyses are inappropriate. Our

view is that such analyses cannot be dismissed for at least two reasons. First, many public policies are implemented by local governments with responsibilities that are confined to political boundaries. Second, regional development determinants can be consistently estimated with any random set of regional boundaries. Interactions and feedback effects, however, across formal regions should be considered in the design of regional development policies. This is one reason why Mexico's planning model, with a heavy dose of CDD and local participation, has great potential, as stated earlier.

Policy evaluation experiences

There were some very early attempts to use shift and share analysis to evaluate the impacts of policies, but this technique is only an accounting decomposition with no real explanatory contribution. Moore and Rhodes (1973) provided perhaps the first real attempt in their examination of British regional policy. They tried to determine the employment increment in assisted areas that had occurred over what might have been expected in the absence of policy. The results were mixed; further, the analysis technique was criticized in part for its dependence on an interpretation of the residuals as providing "explanation" for the policy impact, something that clearly violates the tenets of regression analysis.

Other attempts focused on individual firms or sectors of the economy, on the role of foreign direct investment, and on surveys of assisted firms. More elaborate evaluation procedures have employed cost-benefit analysis and computable general equilibrium (CGE) models. The results, as with the methodologies, are varied, with specific programs in some regions demonstrating welfare gains, but the CGE models that Swales et al. (2000) adopted for Scotland included a "Rest of the UK" component to explore the spillover and feedback effects. In very few cases (see Fingleton 2001) have these effects been considered explicitly, yet they can provide a significant (sometimes unintended) component of the policy itself. In many developing economies where regions are even more open than those in developed countries, interregional leakages can be sizeable and ignoring them creates problems for accurate policy evaluation.

The EU case

This section draws on the excellent review that Armstrong and Taylor (2000) provided and then presents a recent evaluation of regional structural funds (Dall'erba et al. Forthcoming) Armstrong and Taylor (2000) provide four major arguments in favor of EU regional policy:

1. The EU can ensure that regional policy spending by member states does not end up in fiscal wars where poorer states would be at a disadvantage. The EU provides both fiscal transfers and a set of legal controls to monitor the regional expenditures.
2. The EU can help improve regional policy coordination, as the degree of coordination varies across regions and countries, but begins to break down at lower spatial levels (local authorities, for example).
3. The benefits accruing to one (less prosperous) region are likely to spill over to other regions. What has to be demonstrated, of course, is that the diversion of funds from other programs and activities generates greater gains for the EU as a whole.
4. Regional policy is necessary to sustain further integration. The premise here is that strong regional disparities will not only hinder further integration, they may even unravel it. But the EU's enlargement is likely to put even greater strain on resources and priorities; regions that were formally disadvantaged in reference to the existing EU may end up eligible for less funding, since their comparative position will improve with the addition of six countries from Central and Eastern Europe.

In examining the types of programs and targets, several new policies have been developed: enhancing innovation, targeting strategic development opportunities, and finally, focusing on community economic development. The lack of coherence in the EU's regional development policies may appear astonishing, especially when they absorb one-third of its budget and 0.46 percent of its member states' total GDP (€195 billion at 1999 prices over 2000–6). The origin of regional development policies may be found in the EU's evolution. Initially, the European Community wanted to ensure market integration, so cohesion among member states and the reduction of regional inequalities were not a priority. It was only with the first enlargement of 1973, to Denmark, Ireland, and the United Kingdom, that the idea of setting up a regional policy appeared, as it was a condition to their accession. With enlargement then focused on the poorer southern countries, in 1981 to Greece and in 1986 to Portugal and Spain, the lack of cohesion became obvious and generated a demand for structural aid. The process of accelerating deeper integration also required greater efforts towards cohesion among members; the 1986 Single Act was the basis of the Single Market that would

ensure free circulation of goods and people among member countries. A necessary policy condition was rooted in the creation of transportation infrastructures, able to link to the core even the most remote regions. Moreover, with the enlargement to southern countries, the differences in infrastructures among countries were revealed to be even more important than the differences in per capita incomes. The European Commission still considers this lack of infrastructure as the main reason for low convergence, and this helps explain why funds are directed towards the finance of new infrastructures in transport, telecommunication, energy, and education. The amounts allocated to regional development policies were doubled after the 1992 Maastricht Treaty that defined the criteria for a high degree of convergence between economies of members, one of the main prerequisites for introducing a common currency. In the poorer countries, it meant that heavy investments in public infrastructures were necessary to reduce the development gap, but this process had to be accomplished under the constraint of lower public debt or budget deficits. Hence, the only solution was for other member states to reinforce their financial help; as a result, cohesion funds have been allocated since 1994 to Greece, Ireland, Portugal, and Spain.

Cohesion funds provide financial support to countries having a GNP per capita in Standard of Purchasing Power below 90 percent of the Community average, such as Spain (which benefits from 61–63.5 percent of these funds), Portugal (16–18 percent), Greece (16–18 percent), and Ireland (2–6 percent). Total commitments amount to €18 billion at 1999 prices for 2000–6. To more effectively target the eligibility of regions for Community interventions over 2000–6, the European Council of March 1999 reduced the number of structural objectives (or sets of policy instruments) from six to three. Objective 1 is for the development and structural adjustment of NUTS II (Nomenclature of Territorial Units for Statistics) level regions, where development is lagging (regions whose per capita GDP is below 75 percent of the Community average). Almost 70 percent of total Community structural funds are dedicated to this objective. Objective 2 supports the economic and social conversion of regions affected by industrial decline (high long-term unemployment rate, a high poverty level, low education level). Objective 3 supports the adaptation and modernization of systems of education, training, and employment. In practice, the EU Commission has allocated 60 percent of the funds to finance transportation infrastructures and the rest to other investments in public goods, including education and R&D. Perhaps more important is the fact that various macroeconomic models have been applied to evaluate past EU expenditures—see box 9.1.

Drawing on these results, the European Commission concluded that the structural funds have had a significant effect in reducing economic performance disparities across the Union and narrowing the gap in GDP per capita between the four cohesion countries and the rest of the Union, although the analyses are silent with respect to intranational disparities. However, these macroeconomic models may be criticized for relying too much on the positive Keynesian effect of demand. The demand-effects are stronger the higher the unemployment rate and the lower the utilization rate of factors of production such as capital in the region. Of course, they are certainly the most visible and the easiest to analyze and quantify, and they correspond to the political horizon of local deciders. The supply effect, which could include, for instance, the effects of firm relocation on local supply after the building of a transport infrastructure, is much more difficult to measure, however, since many of the policies introduced produce their full effect on the economy only after a number of years.

In addition, there is a potential spillover problem since the demand effects do not necessarily work in the region where funds are targeted. The financing of interregional infrastructure in a country may benefit firms from the richer regions, since they can first ensure their construction and, second, use the new infrastructure to sell their products more easily. Productivity gains associated with Community projects can therefore finance increasing incomes, but not necessarily within the Objective region. Fayolle and Lecuyer (2000) thus note that Objective 1 regions have improved their local productivity more than their per capita income, that is, they do not succeed in using their new productive possibilities to create jobs.

According to the previous results, it cannot be claimed that the objective of "reducing disparities between the levels of development of the various regions and the backwardness of the least favored regions or islands, including rural areas" has been fully reached (Article 158 of the Treaty establishing the European Community). Regional policies have not been effective enough to impede the process of increasing income inequalities among regions in a particular country. Thus even the EU experience seems to demand further analysis for it to really become a model to be emulated by developing countries. A similar uncertainty exists in our understanding of the benefits of CDD programs in developing countries.

BOX 9.1

Macro models used to evaluate EU cohesion funds

Four input-output macroeconomic models are used to estimate the impact of structural funds on growth in the four least developed countries (see, for instance, the "Sixth Periodic Report on the Social and Economic Situation and Development of the Regions of the Community 1999"). They compare developments in the post assistance period with those before and estimate what would have happened if the trend observed in the preassistance period had continued. They assume that there is no change in the behavioral relationships observed in the past and that no new factors emerge during the postassistance period, other than the introduction of the policy itself that affects the outcome. Their results are different, as their assumptions vary about the way demand- and supply-side effects are considered. Note equally that given the data that exist, the models can only really be applied to analyze the development in member states, but not in different regions in countries. The expected effects of structural funds are twofold. Transfers add to income in recipient regions, producing a demand effect on output and employment as the additional income is spent on goods and services. An increase in the productive potential by improving infrastructure and raising the skills of labor and local business is also expected. The second effect (supply effect) is, however, much more difficult to measure since many of the policies introduced produce their full effect on the economy only after a number of years. The model results are summarized in the table below. Some summary comments about each model are provided.

The Pereira model (1994) is a pure supply-side model that focuses on economic efficiency improvements. According to this model, the main underlying reason for increased GDP is the additional investment in the business sector, public sector infrastructure, and human capital triggered by Union intervention. Beutel (1995) presents a largely Keynesian model, incorporating input-output techniques that focus on the overall and sectoral effects of the stimulus to demand. The additional growth in the cohesion countries arises from the increase in investment resulting directly from Community interventions. On average, they are responsible, together with the associated national contribution, for financing over 30 percent of total investment in Ireland and Portugal and over 40 percent in Greece. As a result, 2 to 3 percent of the capital stock in each country was assumed to be due to Community transfers. The impact on employment is notable (+3.5 percent of total employment), but is more limited because private sector capital grants or subsidies were used to increase the capital intensity of production or modernize the plant and equipment. Another leakage effect is the increase in imports (mostly from other EU countries) that followed EU transfers.

Impact of the structural funds on GDP growth: Comparison of simulation results obtained from macroeconomic models (growth effects in percent differential from the baseline)

	Pereira (1994)	Beutel (1995)		Hermin 4 (1995)			Quest II (1996)	
Country	*1994–99 yearly average*	*1989–93 yearly average*	*1994–99 yearly average*	*1994 total effects (% demand)*	*1999 total effects (% demand)*	*2020 total effects (% demand)*	*1989–93 yearly average*	*1994–99 yearly average*
Greece	0.4 to 0.6	0.8	1.0	1.2 (1.1)	9.4 (4.8)	9.5 (1.5)	0.3	0.1
Ireland	0.4 to 0.6	0.9	0.6	6.2 (6.2)	9.3 (5.9)	12.4 (4.0)	0.3	0.3
Portugal	0.4 to 0.9	0.9	1.1	7.0 (1.9)	9.2 (2.9)	8.9 (7.6)	0.3	0.2
Spain	-	0.3	0.5	1.9 (1.9)	4.3 (2.9)	8.7 (1.9)	0.1	0.1

Source: European Commission 1999.
Note: The results must be compared with annual transfers from the structural funds equivalent to 3.2 percent of GDP for Portugal; 3.4 percent for Greece; 2.1 percent for Ireland; 1.1 percent for Spain.

In the Hermin model (see Bradley 1995 and 2000), incorporates both demand- and supply-side effects, the intervention's initial impact comes through the stimulus to demand, since the effect on productive potential takes time to materialize. According to the model, however, the demand stimulus has only a temporary effect on raising GDP growth and dissipates comparatively quickly. The lasting effects come from the improvements in the conditions of production that contribute significantly to increasing productivity and competitiveness. For Portugal, the supply-side effects are estimated to be smaller than for the other countries, partly because a higher proportion of assistance goes to agriculture, while for Spain, the impact is also estimated to be smaller, in this case because of the smaller size of EU transfers relative to GDP.

In the Quest II model (Roger 1996), which also incorporates demand- and supply-side effects, the influence of monetary variables (interest rates, inflation, and so on) is included explicitly. As compared with the Hermin model, it assumes that individuals and private businesses are more forward-looking in the decisions they make about consumption and investment, implying faster responses to policy changes. The model tends to dampen economic growth, since it assumes that fiscal policy is expansionary, which is reflected in higher interest rates, a consequent appreciation of the exchange rate, and (partial) crowding out of private investment. It is then not surprising that the Quest II estimates are lower than those of the other models.

Source: Hewings et al. 2003.

Evaluations of CDD projects

As mentioned above, CDD projects have some clear advantages, but they pose important challenges, thus making project evaluation indispensable. A recent Wassenich and Whiteside (2004) study reviewed the so-called project "evaluations" of 43 World Bank CDD projects. An important question that the authors asked is whether CDD projects perform better than non-CDD projects in terms of delivering public services that actually affect socioeconomic outcomes on the ground. Another relevant question that the study addressed is whether different service delivery mechanisms work best in the context of CDD projects. The rest of this section borrows directly from the Wassenich and Whiteside study.

A review of available evidence confirms the findings of Mansuri and Rao (2003, 19) regarding a lack of robust evaluations that compare CDD interventions to similar projects implemented by less participatory, and perhaps more centralized or top-down, development mechanisms. A central problem here is that even high-quality comparative evaluations often fail to include details on the delivery mechanism used by the alternative provider, especially in how it differs from the CDD approach. The following paragraphs briefly review specific studies focusing on Latin American and Caribbean experiences.

At the district level, Paxson and Schady (2002) compare the Peru FONCODES program's targeting performance to a more centralized government program, INFES. At the household level, FONCODES' poverty targeting performance is compared against both INFES and parents' committees. However, the paper does not provide details regarding differences in implementation mechanisms among the three groups. A collection of studies compared the Nicaraguan Emergency Social Investment Fund's (FISE1) health and education facilities and water and sanitation infrastructure to those that other providers implemented to examine the relative performance in terms of utilization and sustainability. Yet the details are unclear on the implementation and management process that the other providers supported (World Bank 2000, 40–64). Likewise, the evaluation of Honduras FHIS2 used an engineer to technically assess the quality of infrastructure that FHIS implemented in comparison to that of other providers, but the implementation mechanism that the other providers used is not clear from the report (Walker et al. 1999, 37). Hence, thus far there is little evidence to document the relative performance of CDD versus non-CDD initiatives. Further information could be assembled by researching the implementation mechanisms that other providers used that are included in some of the completed studies mentioned above. Finally, there is also little evidence on the relative performance of different delivery schemes in a CDD program. Fortunately, the Wassenich and Whiteside review study provides hope for the future, for they describe future evaluation plans in various countries, including Brazil, that will attempt to deal with some of these analytical issues that remain crucial to help us understand the benefits of CDD projects in sharpening the effectiveness of service delivery by the various government levels.

9.4 The promising future of Latin American and Caribbean regional development policies[7]

The Latin American and Caribbean region is still going through a learning process on regional development policies and implementation strategies. Subsequent to the—largely failed—regional development policies of the 1960s and 1970s, the learning curve is marked by a trial and error process inspired by the good practices of Europe (and East Asia). Latin American and Caribbean countries are accumulating knowledge from experience on four critical questions: sector and territorial scale, incentives, the role of government as a whole, and intergovernment territorial synergies in the territory.

The selection of the initial territorial and sector scale has proven to be a critical factor for coordinating participating actors. In Chile, territorial policies based on improved public investment coordination have helped link isolated producers to production chains. However, large-scale undertakings that involve several governments or agencies might create interinstitutional friction, especially when fiscal transfers and other budget allocations are involved. Given current institutional frameworks, effectively managing common projects across multiple agencies or different governments adds significant risks to a regional policy. Projects that begin at a small territorial scale or in a single jurisdiction find it easier to sustain personal contact among program officers and leaders, achieve legitimacy, foster a sense of partnership, ensure mutual responsibility to manage risk, and build into larger-scale projects.

Multisector programs have a better potential to eventually mobilize the unattended population. However, beginning with a fundamental concept that is well anchored in a single sector minimizes the risks in a project's early stages. This has been the case with Mendoza, Argentina, where a fundamental concept, a credit program that involved intense citizen participation to identify and build infrastructure, was extended to cluster formation and participation in a production chain in wine and many other regional products.

The integral rural development approach continues to inspire local or regional agricultural development in some Latin American and Caribbean countries. Compared to the single-sector gradually growing into multisector strategy, integrated rural development is a highly ambitious—yet still largely experimental and incompletely defined—strategy. It is a process, as opposed to a blueprint, characterized by pragmatic adaptation to local or regional conditions. Despite its variability, it rests on several fundamental principles, most particularly in emphasizing decentralization, participation, and collective action; devolution of managerial functions to communities; following a territorial as opposed to a sectoral approach; introducing payments for environmental and social services; seeking coordination mechanisms with macro and sectoral policy; and reconstructing a set of rural institutions following de-scaling of the state's role. The regional and local community organizations as well as subnational governments could have a role in identifying regional and specific local opportunities and restrictions.

Chile has an institutional mechanism that supports regional and local projects, Corporación de Fomento de la Producción (CORFO). CORFO has been able to align the incentives in enterprises and regional governments to develop projects that raise productivity and competitiveness, increasing employment and improving economic conditions. CORFO's role (and the underlying purpose of government financing) is to promote projects with positive externalities as well as projects that are at a disadvantage due to asymmetric information or a lack of market transparency. CORFO has specific instruments to support investment, innovation, and management. From a regional development perspective, its instruments related to management foster intergovernmental linkages, public-private partnerships, entrepreneurial groups and clusters, and Integrated Territorial Programs such as Salmon, Puerta del Sur, and Innova Bio Bio.

In some Latin American and Caribbean countries, institutional capacity and a lack of experience with projects still limit the opportunities of isolated producers to engage in identification of public investment projects with potentially high rates of return in terms of national development and poverty reduction. In Argentina and Brazil, the federal government is working on the provision of relevant, cluster-oriented market information for regional and local governments, chambers of commerce, and other organizations with dissemination capacity. Argentina, Brazil, and Chile have national policies and screening mechanisms that support selection and transformation of an incipient local or regional idea into adequate project formulation. As a general rule, national governments need to evaluate the economic feasibility of regional development projects.

Latin American and Caribbean countries are learning to minimize the risk of government intervention. The state-led initiatives of the 1960s and 1970s were generally not sustainable beyond state support. Those initiatives were not based on stakeholders' preferences and contributed lit-

tle to understanding the incentives and motivational factors that would ensure appropriation and sustainability by local agents. Fiscal (tax) incentives were either poorly focused and controlled or were granted for projects that had no clear externalities. The new regional development policies are based on the premise that private sector engagement and risk is a sine qua non for sustainability. Engaging local groups and beneficiaries in problem identification, planning, implementation, and results assessment promotes shared responsibility, a sense of ownership, and community confidence, all of which are key to long-term sustainability. Similarly, Latin American and Caribbean decentralization has enhanced the autonomy of regional and local governments that are best suited to enter into partnerships with private interests, including university and analytic groups, for the formulation, mobilization, and expansion that innovative projects demand.

Several themes seem to resonate from this review. While regional policy has been a feature of many countries for well over five decades, success, by any reasonable measure, appears to be elusive. In large part, this stems from the fact that regional policy has rarely been coordinated in an effective pattern with national economic development strategy. A second reason for the lack of success may be traced to a dearth of analytical techniques and models that have been used in policy articulation, monitoring, and evaluation to the same degree that one finds at the national level. As a result, many policies have been launched with little or no analytical research to support the premises under which the programs would be developed. Ex post and ex ante evaluation has been lacking.

One of the most troubling parts of the regional policy agenda has been the lack of recognition of economic structure's role and the way it contributes to enhancing or hindering success. All too often, it has been assumed that the impacts of development funds allocated to one region would be retained in that region. Interregional spillover effects have rarely been considered and, in some cases, these have been large enough to undermine the policies.

Few policies have been advanced with a sense of the time necessary for them to be effective; impatience, in part traceable to the vagaries of political election cycles, has often meant that suboptimal allocations have been made to achieve short-run and more modest goals that may have compromised the ability to achieve larger, but longer-run objectives. Yet regional development policy fads seem to have resulted in a bandwagon effect—fiscal incentives, growth centers, human capital investment, transportation system improvements, and most recently, cluster-based development have, in turn, served as the basis for channeling development funds. But one rarely finds a careful evaluation of the applicability of some of these ideas in different regions in different countries.

Perhaps the most dramatic change has come about in the last decade as regional development policy faces the challenge of operating in a WTO regime. How are countries that are about to embrace the benefits of free trade going to attend to the fact that, in many cases, welfare differences in the country and across regions will likely deteriorate as domestic markets are opened to foreign competition. Even in Europe, the EU's enlargement presents problems for existing members who see the possibility of some of their regions ceasing to be eligible for regional assistance. There is an interesting game theoretic issue here—how should regions behave in the light of threats from foreign competition? The direct impacts may yield only an incomplete guide to the likely total benefits or costs as more complex trading patterns provide results that may change as coalitions change. For example, if country A joins a trade bloc, the benefits to a region in this country may be different than if country B joins and different again if country C joins but not B, and so on.

Global trends imply that these are going to be the dominant issues in policy debates as far as the eye can see. A region's competitive position is likely to be in a continual state of flux. The example of the sudden need to restructure the maquilidora industry in Mexico and Central America provides an excellent example, especially when compared with the rise and decline of the U.S. Midwest manufacturing sector, which took place over 60 or more years. In much the same way that a worker entering the labor force at the present time can be expected to be trained and retrained up to five times during a working career, one may find that regions need to reinvent themselves periodically to retain competitive advantages. Such a process makes regional policy all the more difficult since it will be facing a moving, often unpredictable, target. But it also makes scarce public resources and the provision of public goods more precious, and policy evaluation has thus become indispensable.

Notes

Geoffrey Hewings (University of Illinois) wrote substantial portions of this chapter.

1. This section relies on Elosegui (2003).

2. Law No. 19.640, Dtos. No. 479/95 and 998/98, Res. S.I. No. 141/95 and except S.I.C. and M. No. 436/99.

3. This section draws heavily from Aroche (2004).

4. Research by Gazel et al. (1996) found the benefits to Illinois to be less than 0.5 percent gain in welfare (GSP) from the U.S.-Canada FTA. At the national level, the gains were estimated to be between 0 and 3 percent. Federal and state policy makers who funded the research claimed the models were wrong—they knew that the gains were higher!

5. A similar idea was promoted in the Chicago region to encourage private investment in the south side of the city of Chicago. Detailed analysis of commodity flows, journey-to-work flows, income flows, and consumption expenditures revealed that the south side region's growth would generate the greatest benefit to the region as a whole with significant spillovers to the other parts of the region (Hewings et al. 2001).

6. Over 1994–9, funds devoted to Objective 1 financed a maximum 75 percent of the total cost, but 80 percent in cohesion countries and 85 percent in the most remote regions and the outlying Greek islands. The other objectives financed a maximum 50 percent of the total cost. For the current programming period, the differentiated ceilings are maintained, but the assistance rate also depends on the Community interest in terms of environmental protection and of the promotion of equality between men and women. Lower ceilings are specific to the case of investment in business or infrastructure generating revenue (respectively, up to 35 percent and 40 percent in Objective 1 areas, and 15 and 25 percent in Objective 2 areas).

7. Fernando Rojas and Azul del Villar (World Bank) wrote portions of this section.

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In the history of Latin America and the Caribbean, rural societies have been at the center of both the origins of prosperity and of social upheaval. Rural communities have access to a wealth of natural resources, including arable land and forests, yet they face the highest poverty rates. Often located far from major urban centers, rural communities must overcome restrictions to gain access to public services and private markets—even in those countries where public spending is already higher in rural than in urban areas.

Beyond the City: The Rural Contribution to Development, the World Bank's major annual research study on Latin America and the Caribbean, evaluates the effects of the rural economy on growth, poverty, and the environment, both in the rural space and in the national and regional economy. Prepared by a team of researchers led by Guillermo Perry, the Bank's chief economist for the region, the report brings together new theoretical and empirical treatments of the links between rural and national development. Combined with existing literature, these findings show that the importance of the rural sector has been underestimated and help to identify appropriate public policies that can enhance the sector's contribution to overall national development.

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