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Power, Distortions, Revolt, and Reform in Agricultural Land Relations

Hans P. Binswanger
Klaus Deininger
and
Gershon Feder

If the efficiency of the large commercial farm is a myth, why do markets for the rental and sale of agricultural land rarely reallocate land to the most efficient uses and users (family farmers)?

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Most work on the relationship between farm size and productivity strongly suggests that farms that rely mostly on family labor are more productive than large farms operated primarily by hired labor.

This study began as an inquiry into how rental and sales markets for agricultural land in the developing world affect efficiency and equity. What emerged was the clear sense that great variations in land relations around the world and over time cannot be understood in the common paradigm of property rights and competitive markets. Under that paradigm, land scarcity leads to better definition of rights, which are then traded in sales and rental markets accessible equally to all players. The outcome should be the allocation of land to the most efficient uses and users, yet this rarely happens.

Instead, land rights and ownership tend to grow out of power relationships. Landowning groups have used coercion and distortions in land, labor, credit, and commodity markets to extract economic rents from the land, from peasants and workers, and most recently from urban consumer groups or taxpayers. Such rent-seeking activities reduce the efficiency of resource use, retard growth, and increase the poverty of the rural population.

Binswanger, Deininger, and Feder examine how these power relations emerged and what legal means enabled relatively few landowners to accumulate and hold on to large landholdings. They discuss the successes and failures of reform in market and socialist economies, and the perversions of reforms in both systems, manifested in large commercial farms and collectives.

They survey the history of land relations and the legacies that history leaves. They discuss the three analytical controversies surrounding economies of scale, and the efficiency of the land sales and land rental market.

They discuss the main policy issues and implications of various distortions and successful and unsuccessful reforms in the developing world, including land registration and titling, land taxation, regulations restricting land sales and rentals, fragmentation and consolidation of land, redistributive land reform, and decollectivization.

In an epilogue on methodology, they examine how various strands of economic theory have contributed, or failed to contribute, to the explanation of variations in policies, distortions, and land relations over space and time.

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POWER, DISTORTIONS, REVOLT AND REFORM IN AGRICULTURAL LAND RELATIONS

Hans P. Binswanger, Klaus Deininger, and Gershon Feder

Prepared for the Handbook of Development Economics, Volume III, Jere Behrman and T.N. Srinivasan, editors.

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GLOSSARY

Irrespective of their historical and cultural or ideological origins, the following terms are used in this paper with the definition given below:

Collective Farm: A farm jointly owned and operated under a single management for the benefit of and with work input from the owners of the collective.

Communal Ownership System: A system of land ownership in which specific plots of land are assigned temporarily or permanently to members for family cultivation, while other areas are held in common for pasture, forestry, and collection of wild plants and game. Individual plots may or may not be inheritable or tradeable in internal rental or sales markets. But sales to nonmembers are always forbidden or subject to community approval.

Contract Farming: A contract between a farmer and a purchaser in advance of the growing season for a specific quantity, quality and date of delivery of an agricultural output at a price or price formula fixed in advance. The contract provides the farmer an assured sale of the crop and sometimes provides for technical assistance, credit, services, or inputs from the purchaser.

Corvée: Unpaid labor and sometimes the service of draft animal provided by serfs, tenants, or usufruct right holder to the owner of the manorial estate.

Debt Peonage, Bonded Labor Services: A tribute payment or labor service originating in a defaulted loan.

Family Farm: A farm operated primarily with family labor, with some hiring in or out of labor. Family farming systems may be socially stratified, with wide dispersion in farm sizes and technology levels.

Hacienda: A manorial estate in which part of the land is cultivated as the home harm of the owner and part as the family farms of serfs, usufructuary right holders, or tenants.

Home Farm: That part of the manorial estate or large ownership holding cultivated by the lord, landlord or owner under his own management using corvée and sometimes partly remunerated labor.

Landlord Estate: A manorial estate in which all of the land is cultivated by tenants or usufructuary right holders.

Junker Estate: A large ownership holding producing a diversified set of commodities operated under a single management with hired labor. Laborers do not receive a plot of land to use for their own cultivation as part of their remuneration, except perhaps for a house and a garden plot.

Large Commercial Farm: A large ownership holding producing several different commodities operating under a single management with a high degree of mechanization using a few long term hired workers who may reside on the farm and seasonally hired workers who do not reside permanently on the farm.

Manorial Estate: An area of land allocated temporarily or as a permanent ownership holding to a manorial lord who has the right to tribute, taxes, or rent in cash, in kind or in corvée labor of the peasants residing on the estate. This paper uses the same term whether the peasants are there by

choice or are bound by restrictions on their mobility. Manorial estates can be organized as haciendas or as landlord estates.

Rent is used in several ways:

- ***Residual rent***: The residual payment to a productive factor in inelastic supply after all factors have been renumerated at their respective market rates, whether the other markets are competitive or not.

- ***Rent-seeking rent***: The additional reward received as a result of regulations and restrictions that raise the level of rewards above its undistorted level. Where markets are thin or uncompetitive, measuring rent-seeking rent may be very difficult.

- ***Land rent***: A tenant's payment to a landowner in a voluntary contractual relationship. Rent may be paid as a fixed or share payment in cash, kind, or labor services. It may or may not be equal to residual rent. If the reservation utility of tenants has been reduced by distortions associated with rent seeking, the land rent includes a component of rent seeking.

Reservation utility or reservation wage: The level of utility (including the risk attributes) or the wage which is available outside the manorial estate to a potential tenant or worker on a manorial estate.

Share contract: A rental contract in which the tenant is paying a portion or all of his rent by delivering a certain proportion of the output, the crop share, to the landowner.

State farms: A farm belonging to the state and operated like a Junker estate or a large commercial farm under a single management with a largely resident labor force paid in wages, and sometimes, profit shares in cash or in kind. Laborers may be allocated a small garden plot.

Surplus: Output or labor available over and above that required to reconstitute and maintain the energy and life of peasants, serfs or slaves.

Tribute: A payment in cash, kind or labor services to a landlord based on restrictions on mobility and/or other forms of state-sanctioned coercion. Tribute may also be called rent or corvée.

Usufructuary rights: Rights to use the land. May be temporary, long-term, lifetime, or inheritable, but always exclude the right to unrestricted sale of the land.

Wage plantation: A large ownership holding specializing in a single crop under a single management using wage labor, a large share of which resides on the plantation but does not receive more than a garden plot for self cultivation as part
of the remuneration.

INTRODUCTION

This paper began as an inquiry into the efficiency and equity consequences of rental and sales markets for agricultural land in the developing world. Most of the work on the relationship between farm size and productivity strongly suggests that farms that rely mostly on family labor have higher productivity levels than large farms operated primarily with hired labor. If that is so, why have markets for the rental and sale of agricultural land frequently not reallocated land to family farmers? Why do extraordinarily unequal distributions of ownership and operational holdings persist in many parts of the world? Why has land reform seemed to be necessary to change these land ownership distributions?

What began to emerge from this study was the clear sense that the great variations in land relations found across the world and over time cannot be understood in a simple property rights and markets paradigm. Section 2 explains the idealized sequence of the emergence and definition of property rights which occurred in only few areas of the developing world. As that paradigm would have it, increasing land scarcity leads to better definition of rights, which are then traded in sales and rental markets that are equally accessible to all players. The outcome should be the allocation of land to the most efficient uses and users. Yet this often did not happen, as great observed deviations from efficiency demonstrate.

An examination of the historical evolution of land rights shows the reason for the deviations: rights over land and the concentration of ownership observed in most developing countries at the end of World War II are outgrowths of power relationships. Landowning groups used coercion and distortions in land, labor, credit, and commodity markets to extract economic rents from the land, from peasants and workers, and more recently from urban consumer groups or taxpayers. Such rent-seeking activities reduced the efficiency of resource use, retarded growth, and increased the poverty of the rural population. How these power relations emerged and what legal means enabled relatively few landowners to accumulate and hold on to large landholdings. The terminology describing agricultural production relations varies as much as the relations themselves do. We use a consistent set of terminology and provide a glossary of definitions.[1]

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[1] A large literature elaborates the implications of spatial models of land use following the tradition of v. Thuenen for the optimal use of land and associated problems of localized monopolies (Fujita and Thisse

(continued...)

Because land ownership distribution has often been determined by power relationships and distortions, and because land sales markets do not distribute land to the poor (the key point of section 5), land reform has often been necessary to get land into the hands of efficient small family owners (section 4 shows that they are indeed efficient). The successes and failures of reform in market and socialist economies and the perversions of reforms in both these systems, manifested in large commercial farms or collectives, are discussed in section 3. The social cost of failing to undertake reform-peasant revolt and civil war-are also considered.

But land reform would not be necessary if there were economies of scale in agriculture beyond those that a family could take advantage of with a given level of technology. In that case it would not have been necessary to use power to aggregate large holdings or coercion and distortions to recruit workers. And in modern times it would not have been necessary to subsidize large commercial farms so heavily through credit subsidies and other distortions. Voluntary transactions in undistorted markets would have achieved these ends, and small peasants might have found it attractive to join collectives. Section 4 examines the work that has been done on the presence-or not- of economies of scale in agriculture, finding in measurements of the relative efficiency of small versus large farms only exceptional cases which are consistent with the myth of the efficient large farm.

Similarly, if land sales markets could allocate land from inefficient large owners to small family farmers, land reform would not be necessary. Abolishing the special subsidies to large farms and the conditions that permit coercion would be all that would be required to lead to the breakup of large farms through sales to small farmers. Showing why sales markets are often not capable of facilitating these efficiency-enhancing transfers - covariance of risks, imperfections in credit markets, distortions in commodity market and subsidies to large farms are among the reasons - is the topic of Section 5.

Section 6 then shows that tenancy and sharecropping are not as inefficient as often assumed. They are second best adaptations to incomplete or distorted markets for labor, credit, and risk diffusion. Such rental agreements are also necessary to allow large ownership holdings to be

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[1] (...continued)
1986), regional and urban planning, and the determinants of land values (Randall and Castle 1985). The references cited provide a good overview of this literature.

operated by tenants as small family farm units. Regulating tenancy or outlawing it has perverse efficiency and equity effects for the poor.

The sections of the paper are grouped in three parts. Part I covers the history of land relations and the legacies it leaves today. Part II covers the three analytical controversies surrounding economies of scale, and the efficiency of the land rental and the land sales market. Part III discusses the major land policy issues left behind by the various distortions and successful and unsuccessful reforms in the developing world. These include land registration and titling, land taxation, regulations limiting land sales and land rentals, fragmentation of land, redistributive land reform and decollectivization. Policy implications are discussed using the insights gained in the previous sections.

Finally, the methodological epilogue examines how various strands of economic theory have contributed, or failed to contribute, to the explanation of variations in policies, distortions and land relations over space and time.

PART I: THE HISTORICAL LEGACY

1. The emergence of property rights in land

The critical issue in land-abundant settings is access to labor, not land. At low population densities, there is no incentive to invest in soil fertility, and because fertility is restored by long-tree fallow, ownership security is not required to induce investment. When population densities rise, fallow periods are gradually shortened until the land is continually cultivated. Then plows, manure, artificial fertilizers, and other investments and labor-intensive methods are required to maintain soil fertility (Boserup 1965, Ruthenberg 1980, Pingali et al., 1986). Marginal lands are also brought under cultivation requiring higher investments still to make them productive. Now ownership security becomes an important incentive for making the required investments. As the demand for credit to finance inputs and investments in land improvements rises, the issue of land as collateral becomes important.

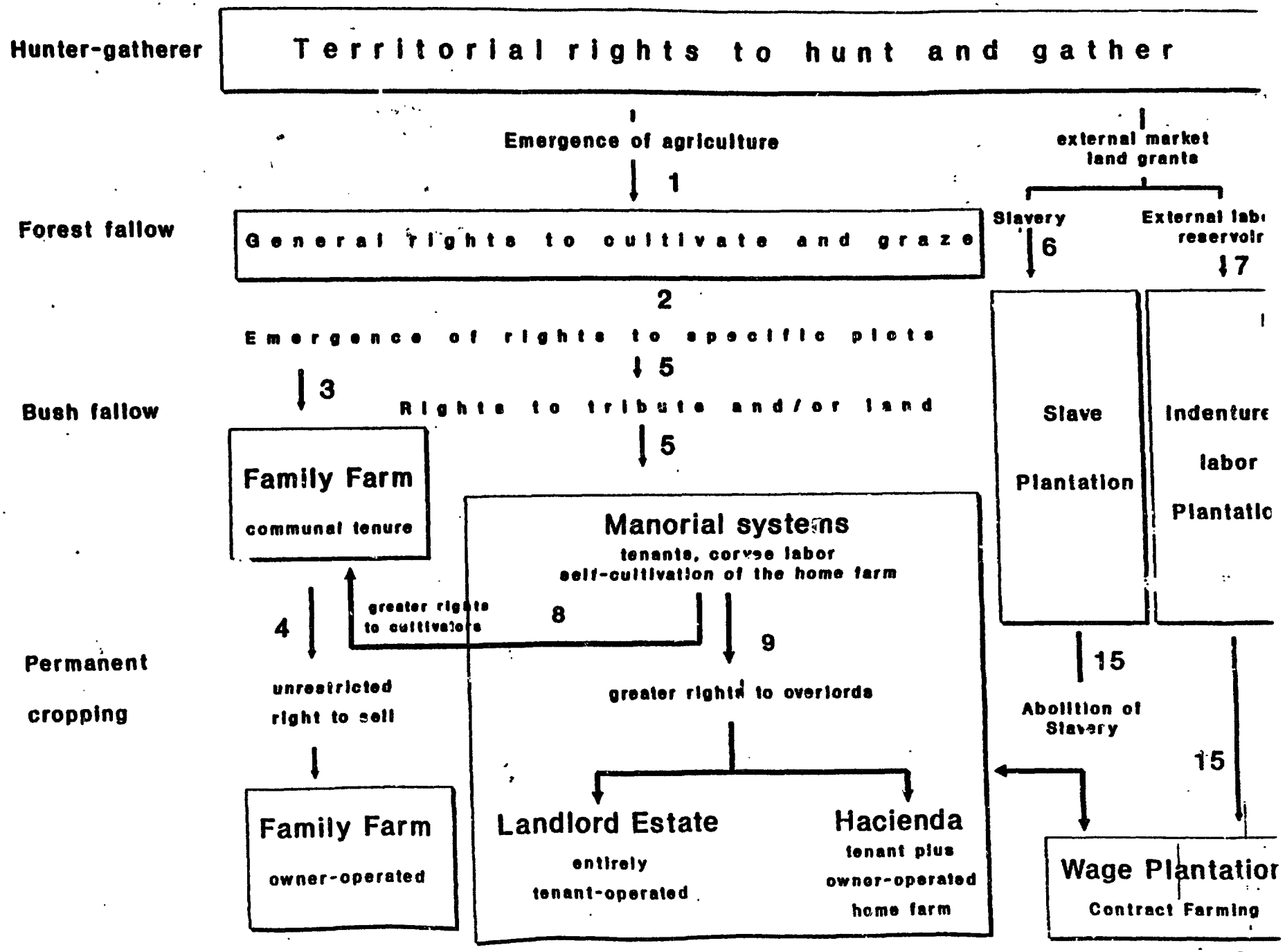
Thus as population density increases private rights to land emerge in a slow and gradual process that exhibits great regularity (figure 1, arrows 1 to 4). Boserup's (1965) discussion of this process is unsurpassed and so is quoted here at length:

Virtually all the systems of land tenure found to exist before the emergency of private property in land seem to have this one feature in common: certain families are recognized as having cultivation rights within a given area of land while other families are excluded .... "Free" land disappears already before the agricultural stage is reached. Tribes of food collectors and hunters consider that they have exclusive rights to collect food and to hunt in a particular area....

Under the system of forest fallow, all the members of a tribe .... have a general right to cultivate plots of land.... This general right to take part in the cultivation of the land which the group dominates - or imagines to dominate - can never be lost for any member of the cultivator families. They may voluntarily leave the territory for a time, but they can then reclaim their right when they return ....

....a distinction must be made between the general cultivation right - as described above - and the more specific right a family may have to cultivate a particular plot of land. Under all systems of fallow a family will retain the exclusive right to the plot it has cleared and cultivated until the harvest has been reaped .... But if, after the lapse of the normal period of fallow, the family does not re-cultivate a given plot, it may lose its right to this particular plot .... Thus, the general cultivation right is an inseparable element of the status as member of the tribe and, therefore, in principle inalienable, while the specific right to cultivate an individual plot is lost by desuetude .... As long as a tribe of forest-fallow cultivators has abundant land at its disposal, a family would have no particular interest in returning to precisely that plot which it cultivated on an earlier occasion. Under these conditions a family which needed to shift to a new plot would find a suitable plot, or have it allocated by the chief of the tribe....

But the situation is apt to change with increasing population, as good plots become somewhat scarce. Under such conditions, a family is likely to become more attached to the plots they have been cultivating on earlier occasions... .


Hunter-gatherer
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external market
land grants
Forest fallow
General rights to cultivate and graze
Slavery
6
External labo
reservoir
7
2
Emergence of rights to specific plots
5
Bush fallow
3
Rights to tribute and/or land
5
Slave
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unrestricted
right to sell
greater rights to overlords
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Abolition of
Slavery
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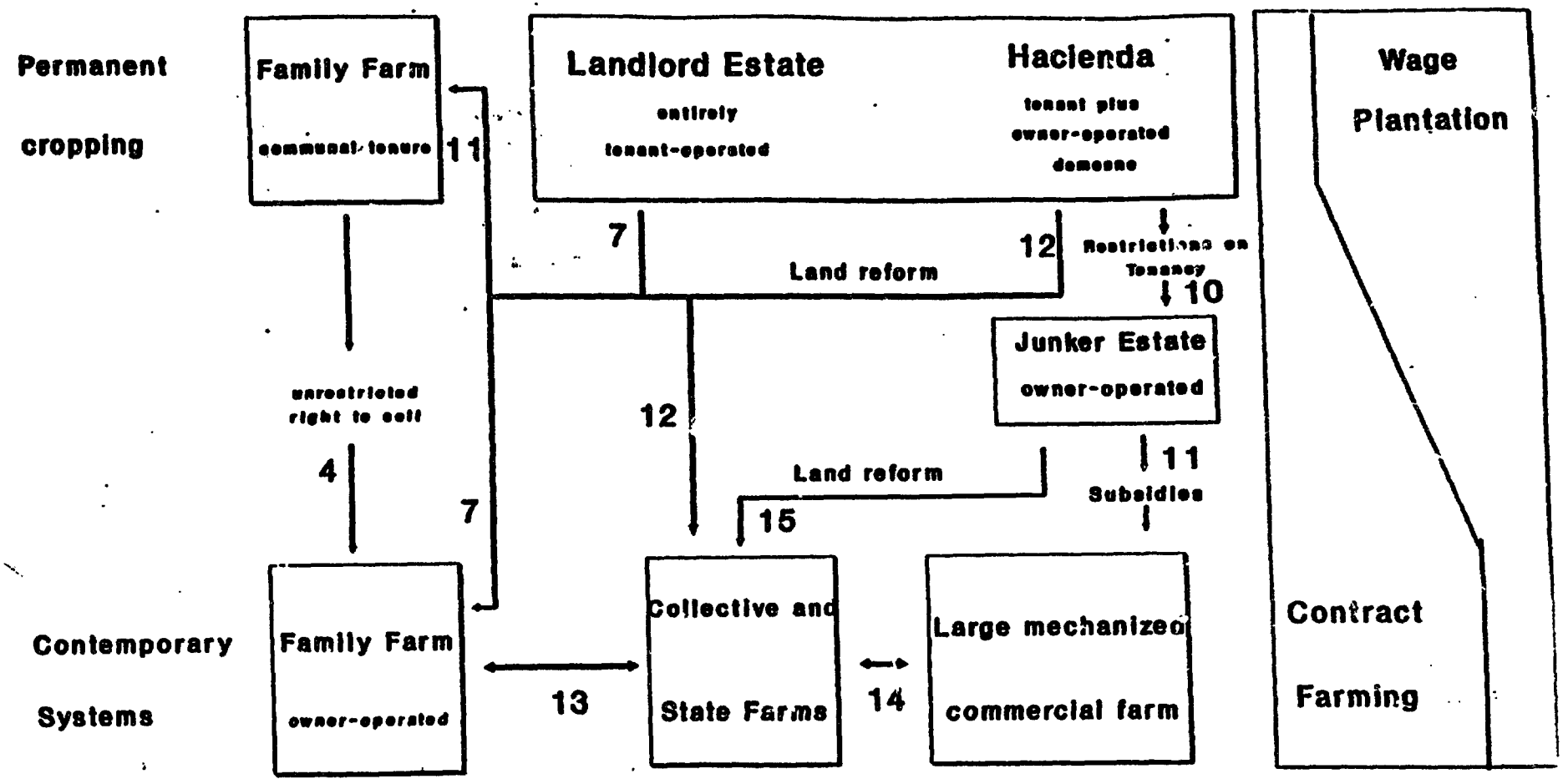
Family Farm
owner-operated
Landlord Estate
entirely
tenant-operated
Hacienda
tenant plus
owner-operated
home farm
Wage Plantation
Contract Farming


Permanent cropping
Family Farm
communal tenure
11
Landlord Estate
entirely tenant-operated
Hacienda
tenant plus owner-operated demesne
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Tenancy regulation
Land Taxation
Redistributive Land Refo
Land Taxation
Contract farming

At this stage, when the attachment of individual families to individual plots becomes more permanent, the custom of pledging land is also likely to emerge. If a family does not need to use a given plot for a certain period it may pledge it to another family .... subject to the condition that the land must be returned, upon request ... . This custom of pledging .... must be distinguished sharply from the sale of land where the former occupier of the land loses all rights in it.

Thus, the attachment of individual families to particular plots becomes more and more important... . As more and more land is subject to specific cultivation rights, little land will be available for redistribution by the chief... .
As long as the general right of cultivation has not lost all its importance a sharp social distinction exists in rural communities between cultivator families on one hand and families without cultivation rights on the other, the latter group consisting of strangers, whether they be slaves or free... even those strangers, who are not slaves in a legal sense, are nevertheless left with no other choice than to do menial work for chiefs or for ordinary members of the dominating tribe... .

Under both long- and short-fallow systems the land lying fallow at any given time is at the free disposal for grazing by domestic animals belonging to families with cultivation rights.... . The cultivators' communal rights to use fallow land for grazing will usually survive long after the general right to clear new forest land has disappeared... . (Boserup 1965, pp 79-86)

Boserup's discussion makes clear that property rights in land are not simple and are rarely unrestricted. As land becomes more scarce, general and inheritable cultivation and grazing rights are complemented by rights to resume cultivating specific plots after fallow (arrow 2), to inherit specific plots rather than just general cultivation rights, to pledge or rent out the plots, to use them as collateral in informal credit transactions, and to sell them within the community (arrow 3). When the right to sell includes sales to members outside the community (arrow 4), the last vestiges of general cultivation rights are lost and private property rights are complete. General rights survive only as grazing and collection rights on communal grazing areas and forests, whose soils are usually unsuitable for crop or intensive pasture production.

Even where communal land rights and management systems prevail, as in indigenous communities of the Americas, or tribal communities in Asia and Africa, families have strong specific land rights. These rights provide substantial "ownership" security as long as the plots are farmed by individual family units (Noronha 1985; Downs and Reyna 1988). Land rental and sales usually occur within the community, especially among close kin.

While the internal rules and structures of these systems exhibit a bewildering variety, all communal systems have one thing in common: Sales to outsiders are either forbidden or subject to approval by the whole community.

The right to sell is often proscribed by laws that assign ultimate ownership to the state or that regulate the land tenure of tribal or indigenous communities. Colonial powers often legislated a uniform system of communal tenure to be applied to all land held by indigenous populations (although tribal societies have often circumvented formal prohibition of land sales; Noronha 1985). Under communal tenure family-owned plots can be used only for pledging in informal credit markets and not as collateral in formal credit markets.

2. Extracting tribute and rent from peasants

History has few examples of the uninterrupted transformation of general cultivation rights to land into owner-operated family farms (along arrows 1 to 4 in figure 1). Nearly always, there has been an intervening period under a class of rulers who extracted tribute, taxes or rent from cultivator families (arrow 5). The landholdings of these overlords (referred to here, for expositional simplicity, as *manorial estates*, whatever the cultural or historic setting) were allocated temporarily or as permanent patrimony or ownership holding, along with the right to tribute, taxes, or rent (in cash, kind, or corvée labor) from the peasants residing on the estate. Frequently, peasants' freedom to move was restricted by bondage or by prior claims to land by members of the ruling group. The rights of the ruling group were acquired and enforced by violence or the threat of violence and institutionalized in tradition, custom, and the law and order forces of the state.[2] The rights took

[2] For Western Europe, North and Thomas (1971) interpret the right to tribute as the emergence of a contract between peasants and manorial lords, with the lords providing protection and other public goods in exchange for tribute. This view ignores the asymmetry in the possession of the means for violence and judicial power.

numerous forms and left historical legacies in the distribution of land once land rights became fully private. Again, Boserup (1965) says it best:

> Above the group of families with cultivation rights is usually found an upper class of tribal chiefs or feudal land who receive tribute from the cultivators... . The emergence of a kind of nobility or aristocracy often seems to follow the introduction of short-fellow cultivation with animal draft power... . Usually the position of a cultivator with regard to his rights in land does not change because a feudal government imposes itself and levies taxes and labor services. The cultivator families continue to have their hereditary cultivation rights, both general and specific, and redistribution of land by village chiefs may continue without interference from the feudal landlords. Nor does land become alienable by sale; grants of land by overlords to members of the nobility and others are simply grants of the right to levy taxes, and do not interfere with the hereditary cultivation rights of the peasants. In other words, the beneficiaries of such grants do not become owners of the land in a modern sense.... (pp. 82-84)

An analytical structure for the evolution of agrarian relations

For an analysis of the evolution of agrarian relations and the associated land ownership distribution, several points are key. The first is that favorable agricultural conditions generate the potential for *rent-seeking rent* or *surplus* and provide an incentive for groups with political and military power to try to capture the rents or surpluses. The second is that under simple technology there are no economies of scale in farming and that independent family farms are economically the most efficient mode of production except for a very limited set of plantation crops; (see section 4). Compared to large farms based on hired or tenant labor, owner-operated family farms save on supervision costs of labor or eliminate the inefficiencies and supervision cost constraints associated with tenancy.

Therefore, where population density is very low, peasants will establish their own farms in the bush and thereby escape paying tribute, taxes or rent to the overlord. Extracting tribute under these conditions requires *coercion.* Or the utility of the free peasant must be sufficiently reduced so that they will offer themselves voluntarily as workers or tenants to holders of large tracts of land at wages, rents or crop shares that provide the same level of utility as would independent self-

cultivation.[3] Coercion is no longer necessary. Utility can be reduced by changing the free peasants' access to high quality land. Large landowners can also try to increase the supply of labor or tenants to their holdings by influencing governments to intervene through differential taxation of owners and workers in large and small holdings, or by limitations on market access that drive down profitability for independent peasants and thus reduce the reservation price of labor. Such economic distortions increase the rent that goes to large-scale farmers at a cost to the economy of lower productive efficiency.

When peasants can freely establish their own farms, it becomes very difficult to operate large farms with hired labor under a single management. With simple technology, there are usually no technical economies of scale (section 4). Lumpy inputs such as draft animals provide for declining economies of scale at very small farm sizes. For larger farms the same draft-animal and driver combination has to be repeated several times over, leading to constant technical returns. Disincentives associated with hired labor give the family-operated farm a cost advantage over large farms: for family members, there are no hiring costs, they have greater incentives to work than do hired wage labor because they receive a share of profits, and third, site-specific learning costs are lower.

Renting out entire small farms to sharecropper families (share tenancy) or granting usufructuary rights to peasants in exchange for tribute allows large landowners to circumvent many of the disincentive effects inherent in large wage-based farming and take advantage of the tenant family's labor. Share tenancy has some incentive costs of its own, however, (section 6) and even under fixed-rent tenancy there are problems of supervision and moral hazard.

Once a labor supply becomes available, large landowners can organize their operations either as *landlord estates*, with the entire estate cultivated by *tenanted* peasants, or as *haciendas*, with workers cultivating portions of the hacienda for their own subsistence as tenants or holders of usufructuary rights and providing unpaid *corvée* or labor services to cultivate the *home-farm* of the owner (see glossary). Since share tenants do not receive their full marginal product, landlord estates based on a lump-sum rent payment would be the most efficient form of operation, followed by landlord estates based on share rents. The hacienda would be less efficient since labor

[3] Taking into account any risk reduction the landowner may be able to provide as part of the bargain.

tenants have few incentives to invest, and landowners' cultivation of the home farm entails labor supervision cost. These points are more fully elaborated now.

Coercion: As Boserup (1965) points out, "Bonded labor is a characteristic feature of communities with hierarchic structure, but surrounded by so much uncontrolled land suitable for cultivation by long fallow methods that it is impossible to prevent the members of the lower class from finding alternative means of subsistence unless they are made personally unfree" (p.73). Four ways have traditionally been used to tie labor to large farms: slavery, serfdom, indentured labor contracts, and debt peonage.

Meillassoux 1981, shows that for *merchant slavery* in which the slaveholders purchase, rather than capture slaves, they must produce for the market to finance the slaves.[4] In areas with sparse populations of hunters and gatherers and with ties to external markets, such as in the United States' Southeast, the East Coast of Brazil, and the South African Cape, large farms had to import slaves as workers (arrow 6).[5] The native hunter-gatherers were too few to provide a steady labor supply, or simply moved away. Large farms in areas with access to abundant labor reservoirs such as the sugar islands of the Caribbean and Mauritius, Ceylonese (Sri Lankan) and Assamese tea plantations, Malaysia, Sumatra, and South Africa were able to rely on indentured labor instead of slaves (arrow 7). The workers had to be indentured to prevent them for the period of indenture at least from establishing plots of their own or going into mining. Laws and police forces were used to enforce indentured labor contracts and to ensure the recapture and return of escaped slaves. The capital cost of slaves, the cash requirements for recruiting indentured labor from distant lands, and the

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[4] Mesailloux also shows that these systems of *merchant slavery* were dependent on systems of *aristocratic slavery* which engaged in the reproduction of the slave population through raids and warfare on widely dispersed subsistence-oriented peasant populations. Domar (1970) relates ownership rights in people - slavery and serfdom - to land abundance, which makes extracting residual land rents impossible. What he did not distinguish is that slavery, the purchase of the labor force, requires high levels of capital, which can be financed only if there is a market, while serfdom involves extracting tribute without a purchase transaction, and so no market is needed.

[5] For a discussion of the transition from slavery to serfdom, see Mesailloux 1991.

absence of cash markets for food in fact implied that these systems could be used only for crops that had an export market.[6]

Serfdom or bondage could be used in somewhat more densely populated regions with a settled peasant population and production primarily for only local consumption (arrow 5).[7] Peasants would have had to move to more marginal lands to escape bondage. Slaves could not be imported because there were no export earnings with which to purchase them. Overlords obtained the right to tie subsistence-oriented populations to the land and to extract tribute or labor services. This pattern arose during feudal periods in Western Europe, China, and Japan, and pre- and post columbian America, and survived in Eastern Europe until the late nineteenth century (Blum 1977).

Debt peonage or bonded labor, another form of coercion, survived in many areas even under high population densities. Where manorial estates had to compete with mines for labor and therefore faced acute labor shortage, as in Guatemala and Mexico in the nineteenth century or in South Africa in the twentieth century, vagrancy laws kept a pool of potential workers in prison for a variety of petty offenses (see table 1). In South Africa farmers could invest in prisons in exchange for rights to prison labor; these rights could even be traded.

Economic distortions

Where coercion was no longer possible, or sufficient, influential groups were able to get governments to intervene to create economic distortions that would generate a labor supply for their farms. Once population density was high enough for long fallow agriculture to replace hunting and gathering, peasants would establish independent farming operations in areas without slavery and

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[6] The temperate zones of the Americas (Canada, North Eastern US, Southern Brazil, and Argentina) escaped slavery because their products could not be exported competitively to temperate zone Europe until the advent of the steamship and the railroad at a time when slavery had gone out of style. The tropical and subtropical crops sugar, cotton, and tobacco faced no competition in European markets.

[7] Mesailloux (1991) also shows that these systems of *merchant slavery* were dependent on slaves for systems of *aristocratic slavery* which engaged in the reproduction of the slave population through raids and warfare on widely dispersed subsistence-oriented peasant populations.

bondage. With identical technology and a competitive output market, cultivation of the home farm with wage labor would not be competitive with the free family farm because of incentive disadvantages and labor supervision costs.

To get free peasants to move to the manorial estate required lowering expected utility or profits in the free peasant sector in order to reduce peasants' reservation utility - expected utility from family farming, including the risk attributes of the corresponding income stream - or shift their labor supply curve to the right. This was achieved through four mechanisms:

- *Reducing the land available for peasant cultivation* by allocating rights to "unoccupied" lands so that they went to members of the ruling class only and thus confining free peasant cultivation to infertile or remote areas with poor infrastructure and market access. (Table 1 lists a variety of cases from all continents in which access to high quality land was restricted). Farm profits or utility on free peasant lands were thus reduced by the higher labor requirements for producing a unit of output on poor land, by increased transport and marketing costs, and by increased prices for consumer goods imported to the region.

- *Imposing differential taxation* by requiring free peasants to pay tribute, hut, head or poll taxes (in cash, kind, or labor services) while often exempting workers or tenants in manorial estates or taxing them at much lower rates. Such systems were used widely in Western Europe during the feudal period, in ancient Japan, China, India and the Ottoman Empire, and by all colonial powers (table 1). Tribute systems in Eastern Europe and Japan survived into the second half of the nineteenth century. As long as free peasants can pay tribute or taxes in kind or cash and have equal access to output markets, taxation alone may be insufficient to bring forth a supply of workers or tenants. They were therefore often complemented by output market inventicas.

- *Restricting market access,* by commonly setting up cooperative or monopoly marketing schemes that buy only from the farms of the rulers. The *prazo* system in Mozambique combined rights to labor and tribute from peasants with monopolies on inputs and outputs. In Kenya the production of coffee by Africans was prohibited

Table 1: Intervention to Establish and Support Large Farms.

COUNTRY	LAND MARKET INTERVENTIONS	TAXES AND INTERVENTIONS IN LABOR AND OUTPUT MARKETS
ASIA: India (North)	Land grants from 1st century	Hacienda system; 4th century BC Corvee labor; from 2nd century
China (South)		Limitations on peasant mobility; ca 500 Tax exemption for slaves; ca 500 Gentry exemption from taxes & labor services; ca 1400
Japan	Exclusive land rights to developed wasteland; 723	Tribute exemption for cleared and temple land; 700
Java and Sumatra	Land grants to companies; 1870	Indentured labor; 19th century Cultivation System; 19th century
Philippines	Land grants to monastic orders; 16th century	Encomienda Repartimiento Tax exemption for hacienda workers; 16th century
Sri Lanka	Land appropriation; 1840	Plantations tax exempt; 1818 Indentured labor; 19th century
EUROPE: Prussia	Land grants; from 13th century	Monopolies on milling and alcohol Restrictions on labor mobility; 1530 Land reform legislations; 1750-1850
Russia	Land grants; from 14th century Service tenure; 1565	Restrictions on peasant mobility: - Exit fees; 1400/50 - Forbidden years; 1588 - Enserfment; 1597 - Tradability of serfs; 1661 Home farm exempt from taxation; 1580 Debt peonage; 1597 Monopoly on commerce; until 1830
S. AMERICA: Chile	Land grants (*mercedes de tierra*); 16th century	Encomienda; 16th century Labor services (*mita*); 17th century Import duties on beef; 1890 Subsidies to mechanization; 1950-60
El Salvador	Grants of public land; 1857 Titling of communal land; 1882	Vagrancy laws; 1825 Exemption from public and military services for large landowners and their workers; 1847
Guatemala	Resettlement of Indians; 16th century	Cash tribute; 1540 Manamiento; ca 1600 Debt peonage; 1877
Mexico	Resettlement of Indians; 1540 Expropriation of communal lands; 1850	Encomienda; 1490 Tribute exemption for hacienda workers; 17th c. Debt peonage; 1790 Return of debtors to haciendas; 1843 Vagrancy laws 1877
Viceroyality of Peru	Land grants; 1540 Resettlement of Indians (congregaciones); 1570 Titling and expropriation of Indian land; 17th century	Encomienda; 1530 Mita: Exemption for hacienda workers; 1550 Slavery of Africans; 1580

AFRICA:		
Algeria	Titling; ca 1840 Land grants under settlement programs; 1871 'Settlers' law' 1873	Tax exemption for workers on European farms; 1849 Credit provision for European settlers
Angola	Land concessions to Europeans; 1838, 1865	Slavery; until 1880 Vagrancy laws; 1875
Egypt (Ottomans)	Land grants; 1840	Corvee labor; from 16th century Corvee exemption for farm-workers; 1840s Land tax exemption for large landlords; 1856 Credit and marketing subsidies, 1920 and 1930s
Kenya	Land concessions to Europeans; ca 1900 No African land purchases outside reserves; 1926	Hut and poll taxes; from 1905 Labor Passes; 1908 Squatter laws; 1918, 1926 and 1939 Restrictions on Africans' market access; from 1930: - Dual price system for maize - Quarantine and force destocking for livestock - Monopoly marketing associations - Prohibition of African export crop cultivation Subsidies to mechanization; 1940s
Sokotho Caliphate	Land grants to settlers; 1804	Slavery; 19th century
Malawi	Land allotments to Europeans; 1894	Tax reductions for farm-workers; ca 1910
Mozambique	Comprehensive rights to leases under prazo; 19th century	Labor tribute; 1880 Vagrancy law; 1899 Abolition of African trade; 1892 Forced cultivation; 1930
South Africa	Native reserves; 19th century Pseudo-communal tenure in reserves; 1894 Native Lands Act; 1912 - Demarcation of reserves - Elimination of tenancy - Prohibition of African land purchases outside reserves	Slavery and indentured labor; 19th century Restrictions on Africans' mobility; 1911, 1951 Monopoly marketing; from 1930 Prison labor; ca 1950 Direct and indirect subsidies; 20th century
Tanganyika	Land grants to settlers; 1890	Hut tax and corvee requirements; 1896 Compulsory cotton production; 1902 Vagrancy laws (work cards); 20th century Exclusion of Africans from credit; 1931 Marketing coops to depress African prices; 1940
Zimbabwe	Reserves; 1896 and 1931	Poll and hut taxes; 1896 Discrimination against tenancy; 1909 Monopoly marketing boards; from 1924 - Dual price system in maize; - Forced destocking in livestock; 1939

outright until the 1950s. European monopolies on sales of tobacco in Zimbabwe and Malawi were directly transferred to large farms after the countries gained independence.

- *Confining agricultural public goods and services* (roads, extension, credit) *to the farms of the rulers* or subsidizing these farms directly was another means of increasing their profitability relative to peasant farms.[8]

Sometimes the four types of distortions were supplemented by coercive interventions in the labor market - vagrancy laws, debt peonage, and rural slavery are examples - to make it easier to retain workers or tenants on manorial estates.

Since these four mechanisms involved legal or customary rules backed by the state, they required a coalition between the overlords and the state. The combinations of distortions used to establish manorial estates under conditions of low population density have been remarkably similar across continents and over time (table 1). The earliest recorded incidence we found was in the Arthasastra in the fourth century B.C. Once members of the ruling group began to establish viable agricultural production getting enough workers for their estates required interventions in more than one market. The most common pattern was to combine restrictions on land use with differential taxation. Groups with widely different cultures, religions, and ethnic backgrounds - Ottomans, the Hausa and Fulani in Africa, the Fujiwara in Japan, and all European colonial powers - imposed such systems on people of the same or different ethnic backgrounds when faced with similar material conditions. Material conditions of production rather than culture seem to have led to the emergence of the distortions.

Production relations on the manorial estate

On both landlord estates and haciendas, corvée, all of part of the land is cultivated by peasants under tenancy contracts or usufructuary rights. In the hacienda, the unpaid labor services of peasants who hold usufruct rights to some plots on the estate is used to cultivate the home farm of the owner. Corvée may include the services of their draft animals and plows. The labor services of tenants constitute all or a part of their rental payments for the use of the land. Peasants may be free to leave the manorial estate or may be bound to it. Sometimes peasants receive a wage payment in

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[8] In Zimbabwe, Africans had been encouraged to cultivate maize through the "Master Farmer Program" in the late 1920s when European farmers found it more profitable to grown tobacco and cotton. When those markets collapsed monopoly marketing and dual price systems were introduced and the Master Farmer Program was abandoned, with responsible officials publicly declaring that they had never intended to "teach the Natives to grow maize in competition with European producers" (Phimister 1988:235).

addition as part payment for their labor. Often, the resident labor force is complemented by seasonally hired wage workers.

The extreme variation in the names and details of these arrangements and in their local evolution over time has long stood in the way of comparative analysis in a single theoretical framework. Yet common elements seem clear.

Landlord estates were prevalent in China, Korea, Japan, Eastern India, Pakistan, Iran, Egypt and Ethiopia. In many colonial environments, it was easy for landlords to restrict peasants' alternatives and maintain control over land and labor and sometimes over output markets. Haciendas emerged as the predominant form of manorial estates in Algeria, Egypt, Kenya, South Africa, Zimbabwe, Bolivia, Chile, Honduras, Mexico, Nicaragua, Peru, and other countries in Latin America, in the Philippines, in Prussia and other parts of Eastern Europe.

The home farm of the landlord often vastly exceeded the area actually cultivated. A major purpose of the huge landholdings was to restrict the indigenous population's possibilities for independent cultivation, and much of the land remained under forest or fallow or was devoted to extensive livestock grazing. At the height of the feudal period in Western Europe between one-quarter and one-half of the total area on manorial estates was cultivated by the owner in the home farm. On Latin American and African haciendas, that share was initially a much lower, one-tenth (Palmer 1979; Chevalier 1963).

Many historical accounts have noted the lack of competitiveness and limited profitability of large-scale cultivation of home farms relative to landlord estates in which all land is rented out. That relative disadvantage is also confirmed by a range of quantitative studies. Records for the eighteenth and early nineteenth centuries show that in all of the cases investigated hacienda owners in Mexico would have been better off by renting out all of their land at rents actually paid by tenants rather than cultivating their home farms (Brading 1978). Many overlords survived economically against competition from independent producers only because of their access to capital markets and large-scale storage of maize which could be sold at high prices in poor years (Florescano 1969). The same applies to many Chilean and Peruvian haciendas in the sixteenth and seventeenth centuries which yielded a return on capital of about 4.5 percent, considerably below the market rate at which the overlords borrowed funds to keep up their living standards. They were able to repay mortgages only because of a rapidly devaluing currency and the appreciation of their land (Moerner

1973:204). Labor productivity and total production on the patrons' plots were about half that on tenants' plots in Peru and one quarter in Ecuador (Pearse 1975:91).

What explains the total amount of tribute, surplus, or rent that could be extracted from the peasants on the manorial estate? The predominant explanation for European estates was a demographic-economic model based on Malthus and Ricardo (see, for example, Postan 1973; Le Roy Ladurie 1966, and 1985; North and Thomas 1971; Brenner 1985; Holton 1977) that relates tribute burdens to relative scarcities of land and labor. Before ruling groups controlled most of the land or were able to coerce labor, attracting or retaining peasants to manorial estates in areas of low population density required that peasants' utility on the manorial estate exceeded their reservation utility for subsistence farming in the bush or in areas from which they had to be induced to emigrate. In Europe east of the river Elbe such terms usually included a grant of hereditary usufruct rights. Initially, most corvée labor was devoted to the construction and maintenance of infrastructure.

As long as population densities were low, corvée requirements had to be regulated and enforced by the state. But as rising population densities and increased land scarcity reduced peasant mobility, it became possible to increase the amount of tribute extracted and to increasingly transform that tribute into obligations to work on the landlord's home farm. Labor requirements, of two to three days a week in feudal Europe, nineteenth century Russia, Kenya in 1918, and Central and South America, began to rise with growing land scarcity. In Kenya, corvée requirements for squatters and their families had risen to five days a week by the end of the colonial period (Resident Labor Ordinance of Kenya, 1939).

This simple demographic-economic model fails to explain, however, why European regions reacted so differently to the plague-induced declines in population in the fourteenth century. The associated drop in tribute contributed to the erosion of serfdom in Western Europe, but led to the reimposition of serfdom in Eastern Europe. In the debate over the demise of feudalism in Europe, Brenner (1976, 1982) clearly established that economic factors such as population density and market access alone are insufficient to determine the income distribution between peasants and lords in the manorial estate. At best, they determine not the actual amount of tribute or surplus that could be extracted from peasants but rather the maximum potential amount. The lords' success in extracting tribute depended on their political power to claim the land, monopolize markets, and control the movement of peasants relative to the power of peasants to resist these efforts.

Bargaining between peasants and lords and the distribution of income

The amount of rent extracted thus depended on the outcome of a bargaining game, the political conflict, or the class struggle over the definition of "property rights" in the widest sense. That means that the cohesiveness of the landlords relative to that of the peasants and the success of the alliances they could forge - with the King, the bureaucracy, other production sectors, the financial sector, and external interests - are central to an analysis of change in the instruments of surplus extraction to landed classes.

In the bargaining over the terms of income distribution between peasants and landlords on the manorial estate, two sets of issues must be dealt with. One is to define the admissible set of property rights and of coercive or voluntary exchange relationships, including the instruments used to enforce such relationships. This problem includes the ability of overlords to impose restrictions on peasant mobility and output markets, the broad terms of legitimate leases (inheritable usufruct, long-term leases, short-term rental), the forms of rental payment available (cash, kind, labor, fixed rent, crop share) and the sanctions (eviction, physical punishment, fines) or instruments that can be used to enforce such changes. The other is to determine optimal mix and level of use of each instrument for maximizing surplus extraction, taking the available options as given. Although this question is more amenable to economic analysis than is the problem of the admissible set of instruments, there has been little formal modeling of it, even for environments without coercion (see, for example, Carter and Kalfayan 1990; Carter and Zimmerman 1992; and Sadoulet 1992).[9]

This second problem could be set up as a bargaining process between landlord and potential tenants. The landlord who maximizes his income or utility subject to the tenant's reservation utility constraint, determines the terms of the tenancy, the size of the tenant's plot, and the size of his own home farm according to the following considerations: he can set the overall rent burden of the tenant. He can partition the rent into corvée, fixed rent payments in cash or kind, and crop shares,

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[9] Carter and Kalfayam (1990) show that the combination of a labor supervision constraint and a working capital constraint can result in the emergence of tied labor contracts. Carter and Zimmerman (1992) provide a dynamic extension of this model and demonstrate the emergence of a number of the salient characteristics of dual agrarian societies as a consequence of credit and labor supervision problems. Sadoulet (1992) explains the emergence of labor service tenancy as a device adopted by the landlord in order to enforce an optimal level of insurance against default by the tenant in the case of crop failure. Covariance of yields between the landlord's home farm and tenants' plots is ignored however. But in years of crop failure the tenants' labor has no value on the home farm either, and forcing him to provide it only leads to extra supervision costs. Sadoulet's explanation therefore fails.

each having its own incentive problems. He can choose the amount of land allocated to home farm cultivation, knowing that incentives are required to bring forth effort and that supervision is costly. He can choose the size of the plot allocated to the tenants, knowing that family farms provide high incentives to produce but may lead tenants to concentrate on their own plot and not supply sufficient effort for home farm cultivation.

With peasants free to leave, the major constraint faced by the landlord is that he cannot drive the utility received by his tenants below their reservation utility - the utility they could receive working in the free peasant sector outside the manorial estate or in an urban labor market. The tenant, for his part, can vary the labor effort on his own farm or leave for frontier areas, indigenous reserves, or urban labor markets. So even without coercion or the ability to affect the reservation utility, the landlord seems to have an abundance of instruments for driving the tenant down to his reservation utility. Without further restrictions on the bargaining problem, its solution may be indeterminate.

Constraints on the bargaining problem imposed by the state - restrictions on peasant mobility, on the size of parcel to be allocated to peasants in inheritable usufruct, or on the tribute, rent and corvée requirements, for example - can simplify the structure of the bargaining problem for specific historical settings. But these outside regulations did change, albeit slowly, in response to such forces as population densities and political conflict, so they can not truly be regarded as exogenous. Thus the complexity of the problem remains.

Rent seeking, coalitions and conflict

The analytical problem becomes even more complex if it incorporates rent seeking or surplus extraction through efforts to change the set of instruments available to landlords. A coalition or class of landlords can try to induce the state to manipulate the reservation utility of peasants and may succeed if peasants or workers are poorly organized to resist the change. We have not found any models addressing these choices or game theory problems formally, but the literature is rich in discussions of changes in the degree of coerciveness of the systems and of changes in other instruments. North and Thomas (1971), for example, in an informally stated bargaining model, analyze the choice between tribute in cash or kind and corvée labor, suggesting that corvée was preferred over tribute in kind where output markets were limited, and the relative prices of goods

were highly variable. There are many other examples, however, of frontier societies without external markets in which tribute was collected in kind.

While the bargaining problem has received little formal analysis, manorial systems have sometimes been interpreted as the outcome of an efficiency-enhancing contract between peasants and landlords: the landlords provide protection and other public goods (which are produced with economies of scale and require some specialization) in exchange for tribute or rent (North and Thomas 1971, for example). This is a plausible interpretation for land-abundant settings, where tribute rates or labor rents have to be set low enough to attract immigrants. However, there are two major problems with this view.

First, it ignores the asymmetry between contracting parties in access to weapons, laws, and public investment budgets. The systematic use of these instruments throughout history has depressed the utility of peasants and workers to far below the reservation utility that would obtain in a system without such symmetric access. Moreover, there is little doubt that substantial deadweight losses and dynamic inefficiencies have been associated with taxes and tribute, with inequalities in factor ratios between farming sectors, and with restrictions on access to credit and output markets.

Second, the contract view ignores the likely competition in rent seeking between landlords, which would add to the deadweight loss associated with restrictions. Competitive rent seeking, the literature shows, is likely to result in the dissipation of the rent into such rent-seeking costs as competitive armies, arsenals, and fortifications, which provide no consumption value. Brenner (1985) argues that at the height of the feudal period, rents were completely dissipated into the costs of competing in the system. Periodic conflicts over the right to extract rent have caused destruction and decline in many flourishing kingdoms and empires, so the efficiency characteristics of the contractual system are only third or fourth best.

Conclusion

The major issue in land relations, then, is the evolution of the relationship between peasants and landlords over time. The best developed literature in this area relates to the demise of the manorial estate, corvée, and bondage and the emergence of capitalism in Europe. Dobb (1976)

interprets the emergence of capitalist farming and the loss of rights to tribute as the consequence of increased population density alone, while Sweeney (1976) emphasizes the role of increased access to markets. Brenner (1985) shows that these explanations alone are inadequate, arguing the need to introduce the cohesiveness of the two groups and the strength of the coalitions they can form with kings or urban groups. Holton (1977) also discusses these issues, as well as broader non-economic theories). In particular, Brenner stresses the importance of the cohesiveness of the peasant community in resisting attempts by the lords to increase the instruments available to them or the intensity of their use.

3. Success and failure in reform

How does the manorial estate disappear? Again Boserup (1965) explains succinctly: "The process by which the feudal landlord tenure [the manorial estate] is abandoned may take different forms: sometimes the position of the feudal landlords in relation to the cultivators is weakened; they lose their power over all or most of the peasants and they end up as private owners of their home farms only [figures 1 and 2, arrows 8, 10, and 11]. In other cases, the feudal landlords succeed in their efforts to completely eliminate the customary rights of the cultivators, and they end up as private owners of all the land over which they had feudal rights, whilst the cultivators have sunk to the status of tenants-at-will. England, of course, is the classical example of this last kind of development" pp 79-87. In transitions of the first kind the peasants end up with the land rent, while in those of the second kind, the landlords retain the rent.

Since land reform involves the transfer of land rents from a ruling class to tenant workers, it is not surprising that most large-scale land reforms were associated with revolts (Bolivia), revolution (Mexico, Chile, China, Cuba, El Salvador, Nicaragua, Russia) conquest (Japan and Taiwan), or the demise of colonial rule (Eastern India, Kenya, Mozambique, Vietnam, Zimbabwe). Attempts at land reform without massive political upheaval have rarely succeeded in transferring much of a country's

land[10] (Brazil, Costa Rica, Honduras) or have done so very slowly because of a lack of political commitment to provide the funding to compensate owners (see section 5).

The outcome of land reforms has been conditioned by three factors: whether the system was a landlord estate or a hacienda system, whether reforms was gradualist with compensation or took place all at once, and whether the reform was undertaken in a market or a socialist economy. We consider the first two factors in the context of the third, the type of economy.

Reform in market-based economies

Rapid transition from *landlord estates* to *family farms* in a market economy (figure 2, arrow 7) has led to stable systems of productions relations. The organization of production remains the same family farm system. The only change is that ownership is transferred from large landlords to tenants who already farm the land and have the skills and implements necessary to cultivate their fields. Government involvement in the transition has often been substantial from a ceiling on the size of landholdings and the amounts to be paid for the land, to the establishment of financial obligations of beneficiaries. Many reforms, that followed this pattern provided stronger incentives for tenant-owners to work and invest in their farms and led to increases in output and productivity. The

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[10] Horowitz (1993) models land reform as the outcome of a Nash bargaining between two agents representing landed elites and the poor. Each party can either agree to a reform proposal or initiate "revolt", defined as a lottery over the three outcomes "victory for the rich", "victory for the poor", and "maintenance of the status quo". The power-structure which, in the case of revolt, determines the probabilities for each of these events is taken to be exogenous and time-invariant. This leads to the definition of a *safe reform plan* as the evolution of landholdings over time which constitutes a Nash equilibrium in the bargaining game between landlords and peasants which, at any point in time, provides each party with a level of utility at least equal to their expected utility in the case of revolt. Horwitz shows that in the case of risk neutrality (i) there exists a unique safe reform plan for every initial distribution of landholdings which can entail either redistribution from the rich to the poor or accumulation of land by the rich; (ii) for any given power structure, the extent of land transfer is the greater of the higher of the initial imbalances in landholdings; (iii) except in special cases, the safe land reform plan is a prolonged process consisting of a sequence of individual reform events rather than a one-time redistribution. This approach is the first formal model in which the dependence of the equilibrium landholding pattern on the power structure is clearly elaborated. The determinants of power, such as coalitions with third groups and internal cohesiveness are not modeled, however, but from the model it is clear that changes in the power structure (such as the changes taking place in many parts of the world after 1945) and the instruments available to landlords to reduce peasants' reservation utility will have major implications for the "stable" land distribution.

resulting systems have had great stability. Since the end of World War II, landlord estates in Bolivia, large areas of China, Eastern India, Ethiopia, Iran, Japan, Korea, and Taiwan have been transferred to tenants in the course of successful land reforms.

Theoretically, the productivity gains associated with such reforms come about because of improved work and investment incentives associated with increased security of tenure. These gains may be modest if tenants had to compensate landowners at near-market prices, if security of tenure had already been high, if cash-rent contracts had prevailed, or if the disincentive effects associated with share-tenancy had been low as suggested by Otsuka and Hayami (1988). Empirical evidence shows that the reform of landlord estates led to considerable investment, adoption of new technology and increases in productivity (Callison 1983; Koo 1968; King 1977; Dorner and Thiesenhusen 1990) and that costs to the government of complementary investments supporting the transition in ownership structure, such as infrastructure, housing, training in management skills, were low because the structure of the smallholder production system was already in place.

By contrast with the relatively smooth transition from landlord estates to family farms, reform of *hacienda* systems has been very slow and difficult. The outcome has frequently been the emergence of large owner-operated *Junker estates* with greatly increased home farm cultivation (arrow 10). Junker estates produce a wide variety of crops and livestock products using a hierarchy of supervisors, permanent workers who sometimes are given a house and garden plot, and external workers hired on a seasonal or daily basis. Junker estates are less specialized than plantations, which produce and process a narrow range of crops (discussed in section 4 on economies of scale), and less capital-intensive than large-scale commercial farms.

Expansion of the landlord's home farm at the cost of land cultivated by tenants for their own use would be associated with losses in efficiency. Therefore, rational landowners would not establish Junker estates unless induced to do so by such external constraints as the threat of land reform or restrictions on tenancy designed to protect tenants' rights. Anticipating such reforms, landowners often tried to reduce their exposure to expropriation by evicting tenants who usually are the beneficiaries of land reform. The lack of competitiveness of Junker estates with the more efficient smallholder sector made Junker estates an unstable form of production relations and led to intensive lobbying for protection and for subsidies to introduce and expand mechanization.

By substituting subsidized capital for labor, the Junker estate was transformed into a *large-scale mechanized commercial farm* (arrow 11) that no longer depended on large amounts of labor. Intensive mechanization of large commercial farms reduces the potential for land reform since there are not enough families with farming skills and implements available on these capital intensive farms to result in the establishment of efficient small farms able to rely on low-cost family labor. A similar result can be achieved by converting haciendas or junker farms to livestock ranches, which requires very little labor.

The early rounds of land reform in Prussia gave freehold property rights to hereditary tenants, requiring them to services give up one-half to one-third of their hereditary land to the Junkers as compensation for the loss of their corvée services. Fearing that further land reform would include tenants at will or holders of nonhereditary usufruct rights the Junkers evicted many of the remaining tenants and reverted to cultivation with hired labor.

In Latin America, ever since the Mexican Revolution in 1910, land reform movements have legally enshrined the principle that land belongs to the tiller and that indirect exploitation of the land through tenants constitutes a cause for expropriation. The Brazilian Land Law of 1964 puts a low ceiling on rental rates and crop shares and conveys permanent usufruct rights to tenants after a few years of tenancy by protecting them from eviction. Similar provisions exist in some land laws in Asia (Chuma and associates 1990). Restrictions on tenant cultivation in South Africa had different roots - they were imposed to make tenancy less attractive to Africans who were needed as workers in the mines. Whatever the motivation, these legal restrictions on tenancy induced owners of haciendas to evict their tenants and to expand home farm cultivation with hired labor, or shift to ranching, which requires little labor, or to adopt mechanization.[11]

That Junker estates emerged only in response to pending land reform and tenancy restrictions supports the view that there are no technical economies of scale in unmechanized

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[11] deJanvry and Sadoulet (1989) argue that the threat of land reform and their ability to lobby in coalition with the urban sector for subsidies and provision of public goods led large landowners to mechanize and make the transition from haciendas to large mechanized commercial farms in Colombia (1961-68), Ecuador (1936-57), Peru (1964-69), Venezuela (1959-70), and in Chile (after 1972). In Ecuador, two separate stages can be distinguished. Widespread eviction of tenants and the formation of Junker estates, until 1957 was followed by a period of increased emphasis on the family-farm sector together with widespread mechanization (1958-73).

agriculture and that the incentive problems associated with supervising hired or corvée labor far exceed the efficiency losses associated with long-term whole-farm tenancy contracts. To compete successfully with family farms, Junker estates had to find ways to reduce their labor costs or to increase their revenues. Having lost their rights to rent or labor services from tenants or workers, landowners often sought to secure rents from the expanding urban and industrial sectors through trade barriers and subsidies for mechanizing production (de Janvry 1981). Trade barriers, by banning or reducing foreign agricultural competition forced consumers to subsidize Junker estates or commercial farms. Examples include the German Zollverein at the end of the nineteenth century (Gerschenkron 1965), tariffs on beef imports in Chile in 1987 (Kay 1992), and selective price support to products from large-scale units in Kenya, Zimbabwe, and South Africa (Deininger and Binswanger 1993). Subsidies for mechanization led to the transformation of nearly all *Junker estates into mechanized commercial farms* (arrow 11). Huge sums were provided either through direct mechanization subsidies, as in Kenya, or through cheap credit, as in South Africa, Zimbabwe, and virtually all of South America, where real interest rates were even negative (Abercrombie 1972). Mechanization eliminated the need to rely on hired labor and resulted in widespread tenant evictions even in countries with cheap labor - hardly an optimal transformation from a social point of view.

In some market economies haciendas were converted to *communal family farm systems* (arrow 11). Communal tenure was adopted first in Mexico's ejido system and later, under land reforms in Bolivia, Zimbabwe, and elsewhere. Beneficiaries were granted inheritable usufructuary rights, but constraints on land sales and rentals often prevented using the land as collateral for credit. Attempts to provide alternative sources of credit through special banks or credit programs proved ineffective (Heath 1992; World Bank 1991). In Mexico, recent constitutional amendment legalizes land rental and sales within all ejidos and allows each ejido to remove restriction on sales to outsiders, by a majority vote, effectively converting the ejidatarios to owner-operated family farms.

Reforms in socialist economies

Reform in socialist economies (figure 2, arrows 10, 11, and 12) has followed different paths. *Landlord estates* in the former Soviet Union, Vietnam, and China were initially converted into *family farms* (arrow 10), in much the same way as in market economies. The redistributed farmlands were later consolidated into single management units or collectives (arrow

13), in which land is owned and operated jointly, under a single management. Families do not operate their own plots as they do in systems of communal ownership.

In Algeria, Chile, East Germany, Mozambique, Nicaragua, and Peru, *Junker estates or large commercial farms* were converted directly into *state farms* (arrows 14 and 15). In most cases, workers continued as employees under a single management, with no change in internal production relations. Over time, the organizational differences between collectives and state farms tended to disappear.

A desire to maintain presumed economies of scale in production and related activities (input supply, marketing) or to educate the beneficiaries of reform during a limited transitional period (Chile), motivated the establishment of collective and state farms. But to achieve efficient production *collectives* have to deal with two incentives problems. One is to provide incentives to workers, a problem addressed by the adoption of piece-rate remuneration systems designed to reward labor at least partially on the basis of effort. Even where members of collectives were not able to divert effort to private plots, lack of incentives and of disciplinary measures by central management led to serious labor shortages following the transformation of private into collectively owned farms in Cuba (MacEwan 1981) and Nicaragua (Enriquez 1992).

The other incentive problem concerns investment and savings decisions, which are made jointly by the collective. Bonin (1985) shows that as long as equity financing is precluded and members cannot market their share in the cooperative, the representative worker will not make efficient investment decisions. Mitchell (1990) also examines problems associated with the intertemporal allocation of consumption and shows that the distribution of decision-making power between old (who would rather consume) and young (who prefer to invest) determines the rate of growth for a cooperative enterprise. Successful collectives tend to degenerate into capitalist enterprises (or wage-labor-operated state farms) by successively substituting cheaper wage laborers for more expensive members (Ben Ner 1984). McGregor (1977) provides a theoretical justification and empirical examples of the tendency of cooperative enterprises to disinvest and to reduce membership in order to increase current consumption by members. Barham and Childress (1992) showed that Honduran collectives decreased their membership over time by about one fifth. Thus, the problems associated with provision of workers' effort and intertemporal consumption proved at least as serious

in collectives as in haciendas (Bonin and Putterman 1986; Putterman 1989). The poor performance of agriculture under a collective mode of production is well documented and it is not surprising that the expected increases in production from economies of scale were not usually realized (see, for example, Colburn 1990 for Nicaragua; Ghai, Kay, and Peek 1988 for Cuba; Ghose 1985, Wuyts 1982, and Griffin and Hay 1985 for Ethiopia and Mozambique, Lin, 1990 for China). Once given the chance to do so, members of collective farms often voted to redistribute plots to family-sized farms.[12] True economies of scale would induce economically rational farmers to establish collective forms of production (Putterman and Giorgio 1985). In the absence of other possibilities of insurance, collective forms of production would be chosen, due to the implicit insurance they provide against noncovariate risks, even in the absence of economies of scale (Carter 1987). However, cooperative production does not insure against covariate risks. Empirical evidence indicates that social ties may be a less costly way to insure against risks that are not covariate (Walker and Ryan 1990).

In China, agricultural output in the first six years after decollectivization in 1978 grew by 42 percent, with most of the growth attributable to the change in production organization (Lin 1992, Fan 1991, McMillan et al. 1989, Nolan 1988). Vietnam experienced similar productivity gains from breaking up large unmechanized collective farms into tiny family units (Pingali and Xuan 1992). The small family farms in these densely populated countries expanded the labor input and were able to reduce machinery and fertilizer use. Clearly, the incentive advantages of individual farming outweighed any efficiency losses due to the extremely small size and fragmentation of farms (Wenfang and Makeham 1992).

Under different conditions, as in Algeria and Peru (Melmed-Sanjak and Carter 1991), the privatization and breakup of mechanized state farms or collectives has been less successful.

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[12] Ortega (1990) offers quantitative evidence for the decline of the collective sector throughout Latin America. In Peru, the absence of economies of scale led reform beneficiaries to effectively subdivide reform collectives by concentrating effort on their private plots and to press for legal subdivisions and individual land titles (Kay 1983; Horton 1972; McClintock 1981). Collectives failed in Zimbabwe and were soon abandoned in favor of a smallholder-oriented strategy (Weiner 1985). Similarly, collectives failed in the Dominican Republic and were replaced by cooperatives, with individually owned plots (Meyer 1991). Land reform cooperatives in Panama are highly indebted and use labor far below profit-maximizing levels (Thiesenhusen 1987). Algerian production cooperatives experienced low productivity, membership desertion, high use of mechanization, and considerable underemployment of the workforce (Pfeiffer 1985; Trautman 1985). The same pattern of declining output and transformation into a "collective Junker estate" has been observed in Mozambique (Wuyts 1985).

Mechanization of these large farms had occurred and had reduced the number of workers or tenants before their collectivization. When these collectives were turned over to their relatively few remaining workers, the resulting family farms were relatively large and unlike in China and Vietnam could not be operated efficiently without additional hired workers or high levels of mechanization. But hiring additional workers dilutes the incentives advantage of the family farm, and the farms had neither the access to subsidized credit nor the large amounts of equity needed to finance hired labor or the mechanization. To make reform work under these capital-constrained conditions and reap the efficiency benefits of family farming may require including more beneficiary families in the reform program than those employed on the highly mechanized farms, by resettling landless or near landless workers from outside the farms (Part III).

The social cost of delayed reform: revolts and civil wars

Maintaining an agricultural structure based on relatively inefficient hacienda systems is costly. In addition to the static efficiency losses[13] there are dynamic efficiency losses associated with the reduced profitability of free peasant cultivation and the accompanying lack of incentives to invest in physical and human capital in the sector. Then there are the resource costs used in rent-seeking to create and maintain the distortions that support the large farms and contribute to rural poverty and inequality. In a competitive rent-seeking equilibrium these costs are equal to the rents. The distortions reduce employment in the sector, imposing an equity cost. Finally, the social costs of failing to reform have often included peasant uprisings and civil war.

Consider Brazil, where the social costs of continued massive distortions in favor of large farms have been substantial (Binswanger 1991) even without violence. Between 1950 and 1980, agricultural output grew at a remarkable 4.5 percent a year, land area expanded at 1.5 percent a year, but agricultural employment grew at only 0.7 percent a year. Over that period, the large-scale farms evicted most of their internal tenants and workers, many of whom migrated to urban slums or ended up as highly insecure seasonal workers without farming skills. An alternative growth path based on

[13] Quantitative estimates of this efficiency loss are scare, but Loveman (1976) estimates that Chile could have saved roughly $100 million a year in agricultural imports during 1949-64 had the 40 percent of land left uncultivated by large landlords been cultivated.

smaller family farms could have provided rural employment and self-employment opportunities for many of these people and gainfully absorbed a substantial share of the rapidly growing population.

In most cases, protracted and violent struggles have significantly reduced the performance of the agricultural sector and the economy as a whole. While peasants have rarely been the initial protagonists in radical class struggles or revolutionary movements many revolutionary movements took refuge in remote areas of limited agricultural potential - sometimes designated "communal areas", "reserves", or "homelands"- where peasants have provided both active and passive support for guerrilla fighters. Many analysts have emphasized the important role of peasant discontent in incidents of regional and national violence (Moore 1966; Wolff 1968; Huizer 1972; Migdal 1974; Scopol and Scott 1976; Christodoulou 1990; and Kriger 1991). The losses from such conflicts are, of course, difficult to measure, but some notion of their magnitude can be gauged from the duration and intensity of such struggles as these cases show:

- In Mozambique, peasants escaped from forced cultivation, vagrancy laws, and forced labor to inaccessible rural areas, which were the main centers of support for the Frelimo guerrillas from 1961 until independence in 1975. (Isaacman & Isaacman 1983). Land reforms which were initiated after independence, however, resulted in highly mechanized collective farms and did not address the problems of the freehold sector. Violence continues to this day.

- In Zimbabwe large scale eviction of some 85,000 families from European-owned farmlands during 1945-51, led to a general strike among Africans in 1948 and provided the basis for peasants' support of ZANU (Zimbabwean African National Union) guerrillas in 1964, (Mosley 1983; Ranger 1985; Scarritt 1991 and Kriger 1991). Guerrilla fighters took up the peasants' grievances over unequal distribution of land and state interference with production and used the Tribal Trust Areas as bases to attack European farms. While a substantial settlement program after independence provided land to Africans, a number of shortcomings limited the success of this program (see Binswanger and Deininger 1993). Policy distortions remained in place despite evidence that large farms are not more efficient than small holder farmers (Masters 1991) and land reform continues to be a major political issue.

- In Guatemala, communal lands were in effect expropriated in 1879 by a law giving proprietors three months to register land titles after which the land would be declared abandoned. Most of the "abandoned" land was then allocated to large coffee growers. Redistribution attempts in 1951-54 were reversed following a military coup in 1954, when virtually all the land which had been subject to land reform was returned to the old owner and farms expropriated from foreigners were allocated in parcels averaging more than 3,000 hectares (Brockett 1984). Since then, there has been a repeated pattern of suppression and radicalization of resistance. Suppression of the cooperative movements of the 1960s led to formation of the guerrilla army of the poor (EGP) in 1972, with its main base in Indian highlands. Peasants responded to a wave of government-supported assassinations in 1976 with the formation of the committee for peasant union (CUC) in 1978. Government massacres of protesting peasants followed (Davis 1983). Almost 40 years after the first attempt at reform, continuing peasant demonstrations signal the cost of failure.

- Smallholder land in El Salvador was similarly appropriated. A decree of 1856 stated that all communal land not at least two-thirds planted with coffee would be considered underutilized or idle, and would revert to the state. Communal land tenure was abolished in 1888. Sporadic revolts led to such countermeasures as the 1888 "security tax" on exports to finance rural police forces, a 1907 ban on rural unions, and the creation of a National Guard in 1912 (McClintock 1985). Areas where land pressures were particularly severe emerged as centers of the revolt of 1932, during which some 10,000 to 20,000 peasants were killed (Mason 1986). Guerrillas promising land and other agricultural reform gained considerable support in rural areas in particular following tenant evictions in the cotton growing lowlands during 1961-70. These evictions led to a 77 percent decline in the houseplots available to tenants as the number of tenants dropped from 55,000 to 17,000. Violence continued to escalate until 1979, when reform-minded officers engineered a coup and introduced land reform in an attempt to preempt a shift in popular support to the FMLN-FDR guerrilla forces. Narrow eligibility rules sharply limited the number of beneficiaries of land reforms and more than a decade of civil war ensued. The peace accord of 1992 mandates additional land reform.

- Colombia also demonstrates the perils of incomplete land reform. Conflicts over land between tenants and large-scale farmers at the frontier escalated from isolated local attacks in the early

1920s to more coordinated tenant actions by the late 1920s. While various kinds of reform legislation were considered during the 1930s, the law finally passed in 1936 vested rights in previously public lands with large landlords rather than the tenants cultivating the land (Le Grand 1982). A series of tenant evictions followed, leading to a quarter century of violence (1940-65) during which guerrillas recruited support from peasant groups. Land reform legislation in 1961 and 1968 regularized previous land invasions but did nothing to improve the operational distribution of land holdings and far fewer peasants benefitted from the reforms than had previously been evicted (Zamosc 1989). Peasant land invasions intensified during the early 1970s, leading to the declaration of a state of emergency after 1974. Regional mobilizations, strikes, and blockades flared up again in 1984, indicated that the conflict is not yet resolved.

- Much of the rural support for the Shining Path guerillas in Peru can be traced to the exclusion of most of the highland Indians from agricultural benefits and the benefits of agrarian reform of 1973 which benefitted primarily the relatively few workers in the coastal area. As a result, more than half the departments in the country have become virtually inaccessible to government forces (McClintock 1984), and public investment in these regions halted, inducing further economic decline and large-scale migrations to the cities, thus exacerbating social tensions and conflicts. Poor economic management during the 1980s and continued activity by Shining Path have led to capital flight and economy wide decline.

Other countries that have experienced prolonged conflicts over land include Angola, Chile, and Nicaragua. While the policies that created and maintain dual land ownership distributions do not necessarily lead to violent struggle - other intervening factors are likely to be important - they clearly played a significant role in many cases.

PART II: ANALYTIC CONTROVERSIES

The first question which is central to the analysis of past and future reforms in agricultural land relations is: Are junker estates and large mechanized farms economically more efficient than smaller, family-operated holdings? The answer is important because if they are not,

equalizing the ownership distribution or breaking up collective or state farms into family farms would enhance both efficiency and equity. In examining the relationship between farm size and productivity, we look first at the sources of economies of scale: economies of scale in processing plants that are transmitted to the farm and generate wage plantations, lumpy inputs that cannot be used below a certain minimum level such as farm machinery and management skills, and advantages in the credit market and in risk diffusion arising from larger ownership holding (section 4). We then summarize the empirical findings on scale economies and diseconomies.

This leads to the second central question for land reform: if, as we find, large operational holdings are usually inefficient, why do large landowners in market economies not rent to family farmers (section 6)? The rental market has historically been the most important mechanism to circumvent the diseconomies of scale associated with large ownership holdings despite the incentive issues associated with tenancy and sharecropping which are reviewed in Section 6. Yet the history of land reform shows that long-term rental of entire farms often implies a high risk of loss of land to tenants, and long term tenancy is no longer an option. Short-term rental of parcels of land cannot create small family-operated holdings. But if tenancy is no longer an option, what prevents the land sales markets from bringing ownership holdings in line with the optimal distribution of operational holdings? Our analysis in Section 5 shows that it is the result of imperfections in other markets, brought about by land-credit linkages and policy distortions.

4. Farm Size and Productivity

Economies of scale in processing

Plantations have historically been established to produce specialized export crops in areas of extreme land-abundance and therefore have had to import slaves or indentured labor. But even after the abolition of slavery or indentured labor, *wage plantations* survived in selected crops as highly specialized large ownership holdings using hired labor to produce a single cash crop. Most workers lived in labor camps on these *wage plantations* and had no subsistence plots of their own to cultivate.

Labor is the largest component of total costs. Grigg (1974) and Courtenay (1980) discuss how the ability to use labor nearly year-round favored the organization of production of these crops under plantations, rather than with tenants or outgrowers. Tree crops such as oil palm, rubber, and tea have the most even demand for labor. Labor demand is more seasonal for sugar and coffee, although irrigation (for sugar) or specific processing (for coffee) can help even out demand.

Wage-based plantations continue to exist for the typical plantation crops - sugarcane, bananas, oil palm and tea because of another technical characteristic. Economies of scale arise from the processing or marketing stage rather than in the farming operations and are transmitted to the farm because of the need to process the crops within hours of harvesting (Binswanger and Rosenzweig 1986). Only for these crops can wage plantations compete with smallholders without relying on coercion to acquire labor.

Economies of scale in processing alone are not a sufficient condition for plantations. The sensitivity of the timing between harvesting and processing is crucial. Easily stored products such as wheat or rice can be bought at harvest time in the open market and stored for milling throughout the year. Therefore, the economies of scale in milling are irrelevant for the organization of the farm. In the case of sugarcane, by contrast, harvesting and processing must be carefully coordinated. If cut cane is left unprocessed for more than a day, much of the sugar is lost to fermentation. And to keep the expensive capital stock operating throughout most of the year processing cane into sugar, cane must be planted at different times of the year, even at times when the sugar yield is not at its maximum. Independent farmers would be unwilling to plant cane during those times without compensation. One way to circumvent this problem is for sugar factories to run their own plantations, with a single manager who decides on the tradeoffs between harvesting cane at suboptimal times and leaving the capital stock idle. Another way is *contract farming* (Hayami 1992; Glover 1990). Contracting with small farmers is widespread throughout India, Thailand, and elsewhere where sugarcane was introduced into an existing smallholder system.

Production of bananas is another example of the coordination problem. Mature bananas must be put into a cold boat within 24 hours of harvest, an immense challenge for the plantation and shipping company. Coordination is required to ensure that the boat will arrive when the bananas are ready to be shipped and that a boat can be filled when it arrives, - for that reason, some

of the world's largest owner-operations are banana companies whose holdings include dozens of plantations operated by hired managers and workers. In Central America, when legislation made it more difficult for multinationals to own plantations, the major banana companies increased their supplies by buying from contract farms. These farms typically have hundreds of hectares and their contracts are so tight that they virtually remain managed by the multinationals (Ellis 1985).

Similarly, rapid deterioration of the harvested product together with economies of scale in processing are the main factors leading to the continued cultivation of tea and oil palm on plantations. Thus the superiority of the plantation depends on a *combination of economies of scale in processing with a coordination problem*. Plantations do not arise - or do not survive once labor coercion is abolished - unless both these conditions exist. Bananas for local and national markets, which are supplied by individual trucks requiring little coordination, are supplied by family farms all over the world. Similarly, traditional unrefined forms of sugar such as muscovado in Central America, where processing did not involve economies of scale, were produced by family farms even in economies dominated by sugar plantations. In many countries coffee and rubber are also cultivated under smallholder systems. They have lower capital requirements for processing than do sugarcane, tea, or oil palm, and therefore, have a smaller optimal cultivated area associated with a single processing unit. Despite their even labor demand over the year, the plantation mode of production has therefore declined sharply at the expense of smallholder production.

The different outcomes for plantations following the abolition of slavery also support the combination hypothesis. United States cotton and tobacco plantations which had no coordination problem, abandoned large-scale cultivation and rented the land out to their former slaves, creating landlord estates (arrow 17). The same thing happened in Latin America, except that some farms became landlord estates and some haciendas (arrows 16 and 17). Slave-operated sugar plantations in the Caribbean and South America, however, converted to wage plantations (arrow 15). There are, of course, other factors at work as well determining what precise pattern of production relations results after slavery is abolished. Klein and Engerman (1985) distinguish three patterns according to relative land abundance and the presence of government intervention.

Today, wage plantations survive in areas where they were first established under conditions of low population density and with a large land grant. Where the same crops were

introduced into existing smallholder systems, contract farming prevails. Processors seem not to have found it profitable to form plantations by buying out smallholders and offering them wage contracts. This suggests either that the coordination problem associated with plantation crops can be solved at a relatively low cost by contract farming or that imperfections in land sales markets are so severe that it is prohibitively expensive to create large ownership holdings by consolidating small farms (section 5).

Lumpy inputs

Draft animals for plowing were the first lumpy input in agriculture. Because of the difficulty of farming using rented draft animals (Binswanger and Rosenzweig 1984), small farmers who lose their draft animals frequently rent out their land until they can acquire new animals (Jodha 1984). *Farm machinery* - threshers, tractors, combine harvester - are much lumpier than draft animals. Tractors and harvesters reach their lowest cost of operation per unit area at a much larger scale than do draft animals, so the optimum operational farm size rises with their introduction. Karl Marx and his followers believed that the economies of scale associated with agricultural mechanization were so large as to make the family farm obsolete. Yet small owners can rent out their land to larger operators (consolidators) rather than sell it, as the ejidatarios in irrigated areas of Mexico have often done. So the initial economy of scale associated with machines does not imply that reverse land reform is needed in areas with many small ownership holdings.

Machine rental can permit small farms to circumvent the economies of scale advantage associated with machines in all but the most time-bound of operations, such as seeding in dry climates or harvesting where climatic risks are high, where farmers compete for first service and therefore prefer to own their own machines.[14] But threshing can be done at any time of the year and as in European agriculture in the late nineteenth century, the expansion of stationary threshers in developing countries today reflects a well developed, efficient rental market. Harvest combines are often rented in the developed and developing world. Most Midwestern U.S. farmers rent them from operators who follow the progress of the harvest season from Oklahoma to Canada. Tractors too are widely rented out for plowing to small farmers in Asia, Africa, and Latin America, but the markets

[14] Binswanger and Rosenzweig (1986) discuss the limits to rental markets imposed by moral hazard and seasonality.

are not as problem free as those for threshers (World Bank 1984). Rao's (1975) analysis of India, shows that small farms' productivity advantage over large farms initially disappeared following the introduction of tractors in Northwest India, but once the size of operational holdings was adjusted upwards, the smaller farms re-emerged with higher productivity rates.

Thus, the economies of scale associated with machines increase the minimum efficient farm size, but by less than expected because of rental markets. The use of draft animals and machines - lumpy inputs - leads to an initial segment of the production function that exhibits increasing returns with operational scale, but these technical economies would vanish when farm size is increased by replicating the optimal scale of lumpy inputs or when rental markets make the lumpiness of machines irrelevant. Under constant technical returns to scale and with perfect markets for land, capital, and labor, the ownership-distribution of land would be irrelevant for production and would only affect the distribution of income. Landowners would either rent the necessary factors of production (labor and capital) and make zero profits operating their own holding or, if there were transaction costs in the labor market, rent in or rent out land to equalize the size of operational holdings.

Management skills like machines, are an indivisible and lumpy input, so the better the manager, the larger the optimal farm size. Technical change strengthens this tendency: fertilizers and pesticides - and arranging the financing to pay for them - require modern management skills. So does the marketing of high-quality produce. In an environment of rapid technical change, acquiring and processing information becomes more and more important, giving managers with more formal schooling and technical education a competitive edge in capturing the innovator's rents.

Therefore, optimal farm sizes tend to increase with more rapid technical change. Some management and technical skills, like machinery, can be contracted from specialized consultants and advisory services or provided by publicly financed extension services. Contract farming often involves the provision of technical advice. But key farming decisions and labor supervision cannot be bought in a market. So limits on management skills will lead to an upward sloping segment in the unit cost curve as operational holding size increases.

Access to credit and risk diffusion

Land, because of its immobility and robustness, has excellent potential as collateral, making access to credit easier for the owner of unencumbered land (the issue is discussed in detail in section 5). Rural credit markets are difficult to develop and sustain. There is therefore severe rationing, which can be partly relieved by the ability to provide land as collateral. The high transaction costs of providing formal credit in rural markets implies that the unit costs of borrowing and lending decline with loan size. Many commercial banks do not lend to small farmers because they cannot make a profit. Raising interest rates on small loans does not overcome this problem, since it eventually leads to adverse selection (Stiglitz and Weiss 1981). For a given credit value, therefore, the cost of borrowing in the formal credit market is a declining function of the amount of *owned land*. Land ownership may serve as a sign of creditworthiness in informal credit markets as well.

Access to credit is particularly important in developing countries because they usually lack other intertemporal markets to insure against crop or price risks. Insurance is sometimes available for very narrowly defined specific risks such as hail or frost, but only for very large farms. Forward markets are often banned or discouraged by policy intervention. An interested local insurer would have enough information to overcome the moral hazard problem, but the covariance of crop yields makes the risk uninsurable at the local level. A national insurer could overcome the covariance problem, but lacks the local information to overcome the moral hazard problem. The absence of a market for multi-risk crop insurance is the result of the combination of moral hazard and the local covariance of production risk. The absence of crop insurance and forward markets confers special importance on access to credit as an insurance substitute, but the combination of covariance and moral hazard also sharply reduces the potential of financial intermediation in rural areas (Binswanger and Rosenzweig 1986).

Providing funds to overcome emergencies is a common function of informal rural credit markets. But the amounts small farmers can borrow for consumption are usually tiny - and often at high interest costs (Binswanger 1985; Christensen 1989; Morooka and Hayami 1990; Udry 1990; Deaton 1991). Investigations into how farmers and workers cope with disaster show that credit finances only a small fraction of their consumption in disaster years (Jodha 1978). Access to formal commercial bank credit therefore gives large modern commercial farms a considerable advantage in risk diffusion over small farmers without such access.

Farmers and workers with little or no access to credit can attempt to diffuse their risk by relying on accumulated reserves and wealth, social relationships, and risk-sharing arrangements in land, labor, output and input markets (Jodha 1978; Bidinger and others 1990; Rosenzweig 1988; Deaton 1990; Sharp 1990). Wealthy individuals can self-insure much more easily than the poor both directly, as a consequence of their wealth, and indirectly, because geographically dispersed social networks on which they can rely in years of (locally covariate) poor harvests. Wealthy farmers should therefore be better able to accumulate profit-maximizing portfolios than poorer farmers, giving them an allocative efficiency advantage.[15] In land-scarce environments, the bulk of a farmer's wealth is in the form of land, so large ownership holdings are correlated with a better ability to diffuse risks through the wealth effect and land's robustness as collateral for credit. Forescano (1969) suggests that in high risk environments, the superior ability of land-rich individuals to diffuse risk through storage and better access to credit markets might have been an important reason that otherwise unprofitable demesne cultivation survival in the face of competition from family farms.

Evidence on farm size - productivity relationship

The literature demonstrates that imperfections in a single market would not be sufficient to introduce a systematic relationship between farm size and productivity per unit of land. For example, if credit is rationed according to farm size, but all other markets are perfect, land and labor market transactions will produce a farm structure that equalizes yields across farms of different operational size. But if there are imperfections in two markets, land rental and insurance, or credit and labor, a systematic relationship can arise between farm size and productivity.

Srinivasan (1982) has shown that under conditions of fixed farm size (no land rental) and no insurance, uncertainty and risk aversion can lead to an inverse relationship between farm size and productivity, provided that absolute risk aversion does not increase and that relative risk aversion does not decrease with wealth. With credit and labor market imperfections, the relationship is not necessarily inverse. For example, Feder (1985) and Carter and Kalfayan (1989) demonstrate that with certain model parameters, the combination of credit and labor market imperfections can lead to a

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[15] As explained in Binswanger and Rosenzweig (1986), they are not able to provide insurance to small farmers because covariance of income would require large reserves in order to be able to offer credible contracts.

U-shaped relationship. Eswaran and Kotwal (1985) obtain an inverse relationship by adding a fixed cost of production to labor and credit market imperfections. Generally, the presence of multiple market failure can explain a variety of farm size distribution and productivity structures.

The implications of imperfections in labor, credit, and land markets are illustrated by Feder (1985) whose model is replicated in Appendix 2. By assumption, the efficiency of hired labor depends on the intensity of supervision by family labor, implying that family labor and hired labor are complements and that the amount of labor effort or "efficiency" units supplied increases with supervision.

If credit and land rental markets are perfect, the supervision constraint alone would lead each household to lease in or lease out the amount of land required to maintain a uniform ratio of family labor endowment to operated area. The ratio of effective labor input to operated area would be constant for all cultivators, whatever the distribution of land ownership. No farm size-productivity relationship would exist.

But if there is a binding constraint in the credit market whereby the supply of working capital depends on the amount of land owned, the optimal size of the operational holding would vary systematically with size of the owned holding even if land rental markets were perfect. The magnitude (and direction) of this variation would depend on the relative elasticities of output with respect to effective labor and of labor effort with respect to supervision.

Now, if, in addition to a supervision constraint and a credit constraint, there are no rental markets for land - whether by law or because of the threat of land reform - a negative relation between farm size and land productivity is likely to emerge. Of course, the capital cost advantage of large farms does not necessarily lead to higher investments on the farm if the capital can be invested elsewhere in the economy at higher returns than in agriculture.

The Evidence for Diseconomies of Scale

The discussion thus far suggests several approaches to the measurement of the farm size-productivity relationship:

- Since the supervision costs vary with the *operational holding* size while the capital constraint is related to the *ownership holding size*, the separate effects of operational and ownership holdings should be distinguished in any test of the farm size-productivity relationship. To eliminate errors resulting from the raw correlation of farm size and household size, regressions of an efficiency indicator on operational and ownership holding size should also include the number of adult family members who can act as supervisors. None of the existing studies has taken full account of these distinctions.

- *Proper measures of relative efficiency are the difference in total factor productivity between small and large farms and the difference in profits, net of the cost of family labor, per unit of capital invested.* Using market prices to measure productivity assesses differences in private efficiency. Using social opportunity costs as a measure eliminates the impact of distortion and measures differences in social efficiency. Few studies have made this distinction.

- Most of the literature has analyzed *physical yields* of specific crops or the *value of agricultural output* per unit of operated area. These are not relevant measures of overall private or social efficiency since they are but partial productivity indices that do not take into account differences in input and labor use. Because part of the adjustment to incentive problems and other market imperfections is to vary the output mix so as to save on the factors with the highest scarcity value in the specific farm, focusing on a single crop is inappropriate except in monocrop farming systems. Individual crop studies are therefore not relevant to the farm size-productivity relationship problem.

- Normalizing any productivity measure by *total land area* or regressing it on land area raises severe measurement problems because agroclimatic potential and land quality differ across regions. The same problem afflicts any comparisons that involve pooled data or use the means from several regions (e.g., Thiesenhusen 1990; Deolalikar 1981). Land quality differences within regions are often so large that adjustments must be made for those differences if productivity is measured per unit area rather than per capital invested (Bhalla and Roy 1988). Only if there is no correlation between land quality and farm size is such an adjustment

unnecessary[16] - or if the differences arise from farmer investments in tubewells, land levelling, drainage, or the like.

The following test of the farm size-productivity relationship is one way to take these considerations into account describing not a causal relationship but a multiple correlation:

$$P/K = g(OP,OW,H,Z) \quad \textit{with expected signs } g_1<0, g_2>0, g_3>0, \quad (1)$$

Where K is assets, L is labor, P is private or social profits net of private or social cost of family labor, OP is operated area or value of operated land, OW is owned area or value of owned land, H is the number of household workers, and Z is a vector of exogenous land quality, distance from infrastructure, and exogenous land improvement variables. g_1 should be negative because of rising supervision costs. g_2 should be positive because ownership provides better access to credit. And g_3 should be positive because family members have incentive to work and can supervise.

None of the studies of the farm size-productivity relationships have applied this full specifications and few studies have even looked at total factor productivity or farm profits net of the cost of family labor. So we must be content to summarize the findings of farm-level studies within small regions that look at value of output per operated area. Typical findings are presented in table 2, which is extracted from Berry and Cline (1979) and similar results are found in a range of other studies.[17]

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[16] Both distress sales (Bhagwati and Chakravarty 1969) and differential patterns of investment (Sen 1964) could explain theoretically why small farmers could systematically end up with higher quality land within a given village. Few empirical studies exist at a sufficiently disaggregated village level to confirm this association. For six villages in semi-arid India, Walker and Ryan (1990) reject the existence of a systematic association between farm size and land quality.

[17] For six Latin American countries Lau and Yotopoulos 1971, and 1979, Barraclough and Collarte 1973; for northeastern Brazil Kutcher and Scandizzo 1981 ; for fifteen countries in Africa, Asia, and Latin America Cornia 1985; for the Indian Punjab Sen 1981; for India and West Bengal Carter 1984; and for India disaggregated into seventy-eight agroclimatic zones Bhalla and Roy 1988. Dyer 1991 describes the array of instruments used by large producers in Egypt to increase their competitiveness with small farmers, demonstrating that large producers can successfully lobby for measures to counteract the inverse farm-size productivity relationship. The need for such rent-seeking implies the continued validity of this relationship although Dyer interprets it to mean the opposite.

TABLE 2: Farm-size productivity differences, selected countries

Farm size[a]	Northeast Brazil[b]	Punjab, Pakistan[c]	Muda, Malaysia[d]
Small farm (hectares)	563 (10.0-49.9)	274 (5.1-10.1)	148 (0.7-1.0)
Largest farm (hectares)	100 (500+)	100 (20+)	100 (5.7-11.3)

Notes:
[a]100 = largest farm size compared with second smallest farm size. Second smallest farm size used in calculations to avoid abnormal productivity results often recorded for the smallest plots.
[b]Table 4-1. Northeastern Brazil, 1973; Production per Unit of Available Land Resource, by Farm Size Group, p.46. Index taken using average gross receipts/areas for size group 2 (small) and 6 (large), averaged for all zones excluding zone F, where sugarcane and cocoa plantations skew productivity average for large farms.
[c]Table 4-29. Relative Land Productivity by Farm Size: Agricultural Census and FABS Survey-based Estimates Compared, (1968-9) p. 84. Index taken using value added per cultivated acre for second smallest size group and largest.
[d]Table 4-48. Factor Productivity of Muda River Farms by Size, Double Croppers, 1972-3 p. 117. Index taken from value added in agriculture/relong (0.283 ha = 1 relong).

Source: Berry and Cline (1978)

These studies support the following generalizations:

- The productivity differential favoring small farms over large one increases with the differences in size. That means it is largest where inequalities in land holdings are greatest, in the relatively land-abundant countries of Latin America and Africa, and smallest in land-scarce Asian countries where farm size distributions are less unequal.

- The highest output per unit areas is often achieved not by the smallest subfamily or part-time farmers but by the second-smallest farm size class, which includes the smallest full-time farmers. This suggests that the smallest farms may be the most severely credit constrained.

- Plantation crops as represented by sugarcane production in Brazil, do not exhibit a negative farm size-productivity relationship (Cline 1971; Kutcher and Scandizzo 1981).

- When land is adjusted for differences in quality using land value or exogenous land quality measures, the negative productivity relationship weakens but does not disappear, especially where it is very large.

- Introduction of the green revolution technology in India led to a weakening but no the disappearance of the raw productivity differentials (Bhalla and Roy 1988).

Three studies came closer to the specification in equation 1. For the Muda River region of Malaysia, Berry and Cline (1979) found that value added per unit of invested capital for the second smallest farm size group exceeded that of the largest farm size group by 65 percent, more than the difference in value of output reported in table 2. The use of value added adjusts for costs of purchased inputs, but this measure is still likely to bias the test in favor of small farms to the degree that small farms use labor more intensively than do large farms. But since the result holds for raw output, the negative relationship would probably hold as well if the test were based on net farm profits. The results suggest that well-developed rental markets, as in the Muda area for tractors and threshes, enable small farmers to circumvent the economies of scale associated with tractors, leaving labor supervision costs to dominate.[18]

In the second study, Berry and Cline (1979) first split the data for Northeast Brazil (see table 2) into agroclimatic zones, which sharply reduced the observed negative relationship. "Social" profits were then calculated by imputing a real opportunity cost of 15 percent to capital and valuing family labor at 0, 50 and 100 percent of the minimum wage, a wage rarely paid in agriculture. Even when family labor is valued at the full opportunity wage, social profits are clearly higher by 23 to 150 percent for the second smallest farm size group (10 to 50 hectares) than for the second largest and the largest farm size groups (200 to 500 hectares) in four of six non-sugar growing zones. For the two zones where the relationship does not hold as clearly (Bahia and Sertao), the weakness of the results appears to be due to paucity of observations (Kutcher and Scandizzo 1981). The negative

[18] Only a few studies explicitly test for the separability of family and hired labor. Pitt and Rosenzweig (1986) show for a sample of Indonesian farmers that profits are independent of the short-term health status of the household head, but since short-term illness does not interfere with supervision the result says little about whether wage labor can complement family labor on a permanent basis. Deolalikar and Vijverberg (1987) reject the hypothesis of perfect substitutability between family and hired labor based on samples from India and Malaysia, but because they estimate a production function using cross-section data, statistical problems vitiate their findings. Benjamin (1992) estimates a demand function for aggregate labor services. He rejects the hypothesis of nonseparability for Indonesian rice farmers on the basis of the joint lack of significance of demographic variables. Since his model includes area harvested as a dependent variable, it does not allow for adjustments of area operated (via rental) in response to family size. In effect, then, the model measures only the conditional impact of demographic variables, given operated area, on the demand for hired labor. The fact that area operated (which, has significant influence on labor demand) is correlated with family composition suggests that a strong supervision constraint might be found if the unconditional effect were considered.

productivity relationship still holds in the technologically advanced Agr[illegible] region, where mechanization was most pronounced if social profits are considered.

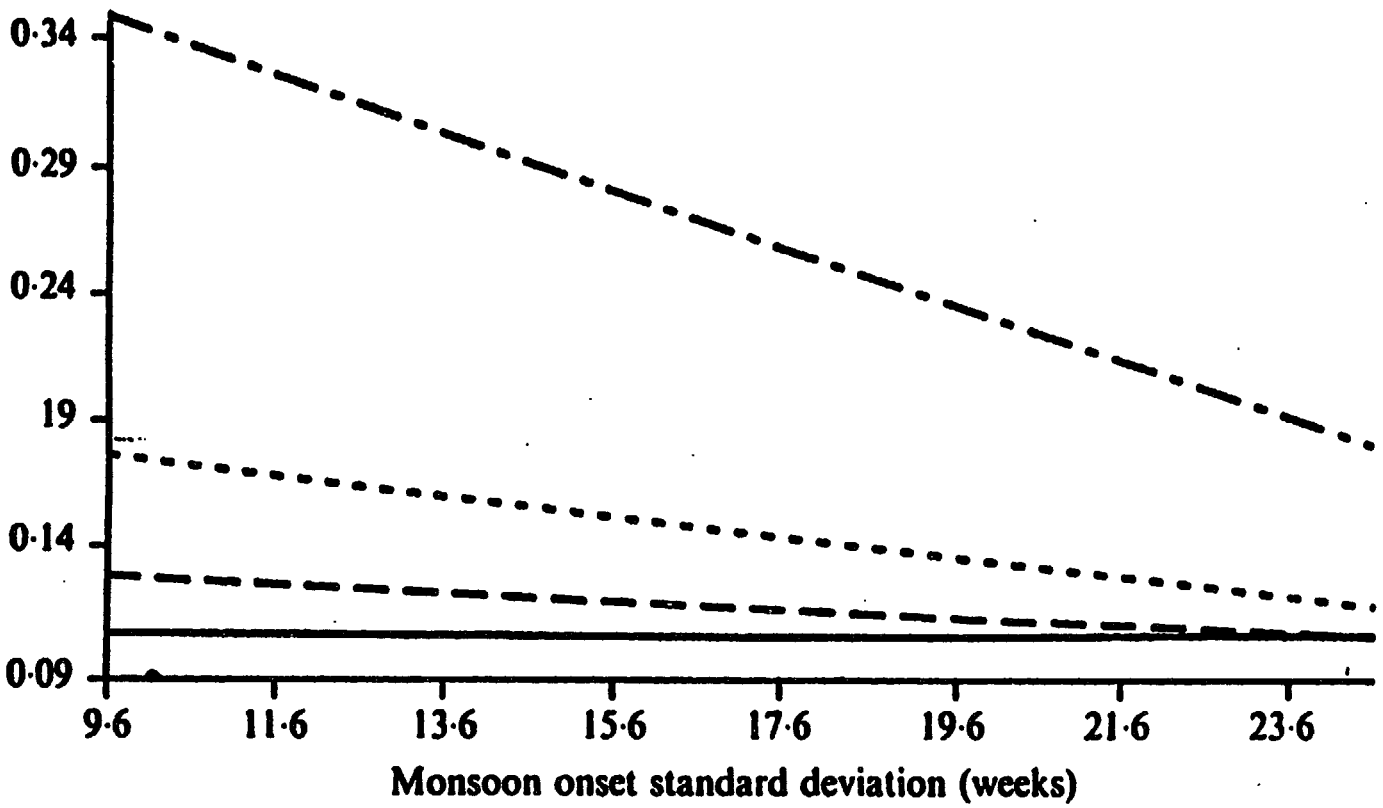
In the third study, Rosenzweig and Binswanger (1993) estimate a profit function similar to equation (1) which include total assets, the composition of the asset portfolio, family labor, education, age, and the onset date of the monsoon. They use the complete ICRISAT panel data from ten villages in high-risk semi-arid India to estimate a model that allows for separate testing of technical economies of scale on the one hand and the impact of supervision cost advantages of poorer farmers relative to the capital cost and risk diffusion advantages of wealthier farmers on the other hand. Fixed-effects estimation techniques were used to eliminate problems of land quality differences. The results reject the hypothesis that the composition of investments reflects technical scale economies. They support the hypothesis that the asset portfolios of farmers are significantly affect by farmers' risk aversion, wealth, and the degree of monsoon onset variability (a measure of weather risk). In an environment of slowly changing technology, the profitability of the portfolio is not affected by formal schooling, but it does rise with age, a proxy for experience. Profits (net of their wage costs) also increase with the number of adult family members, suggesting that their contribution arises from their management and supervision function.

Rosenzweig and Binswanger also estimate the impact of weather risk and wealth on the riskiness and profitability of farmers' asset portfolios. Figure 3 plots the profit per unit of asset for four wealth classes as a function of rainfall variability (onset of the monsoon). The profit rate of farmers at the eightieth percentile of wealth is insensitive to increases in weather risk, suggesting that they are confident enough in their ability to diffuse risk through credit, savings, or social relationships that they do not need to choose portfolios that reduce risk up front at some cost in profits. Farmers in the 20th percentile, however, sharply reduce the profitability of their portfolios as rainfall risk rises.

Despite these portfolio adjustments, this high risk environment with relatively little mechanization and slow technical change, the smaller farm size groups have higher profits per unit of wealth at all levels of rainfall risk observed in the data. The supervision and labor cost advantages of family labor are apparently greater than the advantages that the lumpiness of management skills and machines and the better access to credit and other risk-diffusion measures confer on large farms. Only in the most risky environments does the advantage of the poorer farmers nearly disappear.

Figure 3.

Profit-Wealth Ratios and Weather Variability, by Wealth and Class



3. Profit–wealth ratios and weather variability, by wealth class. Percentiles: ——, 20th; – – –, 40th; ····, 60th; – · – · –, 80th.

Note: The onset date of the Monsoon was the single most powerful of eight different rainfall characteristics to explain gross value of farm output.

Using a nonparametric approach to estimate a production function for Wisconsin farmers, Chavas and Allier (1993) study farms in a very modern and dynamic environment. They find virtually no scale economies in dairy production and only very limited initial scale economies due to lumpiness of inputs.

Conclusion

Most of the empirical work on the farm size-productivity relationship has been flawed by methodological shortcomings, and has failed to deal adequately with the complexity of the issues involved. Studies that come to grips with some of the shortcomings and use a more refined measurement of land quality and a productivity variable instead of simple yields find that even in fairly technologically advanced and mechanized areas, such as the Muda scheme in Malaysia or the Agreste region of Northeast Brazil, small farms retain a productivity advantage over large farms. This finding suggests that rental markets can substitute to a certain degree for the indivisibility of machines and some management skills. The methodologically sounder study based on the ICRISAT data confirms both the mechanisms leading to differential performance by scale and the superiority of smaller farms in an environment with little mechanization and slow technical change. While there is evidence on the negative relationship between farm size and production, more work is needed on this subject. Such work should follow the lines sketched out in equation 1, using recent farm level data for developing country regions with high quality agroclimatic and soil conditions, substantial mechanization, and dynamic technical change.

5. The effects of land-credit links and policy distortions on land sales markets

The farm-size productivity studies indicate that for given technology, factor prices, land quality, and farming skills there is an optimal *operational holding* size at which the disincentive costs of adding more workers fully offsets the economies of scale from lumpy inputs, access to credit and management skills. Taking into account differences in farming skills and land quality, this finding translates into an optimal distribution of operational sizes. For any given distribution of ownership holdings, one would expect tenancy and land rental markets to bring the distribution of operational holdings close to that optimal distribution. If incentive problems associated with tenancy are minor

and can be ignored, the distribution of ownership holdings would be independent of the distribution of operation holdings, since large landholders would simply rent out their land with no loss in efficiency.

But if legal restrictions on tenancy make this option infeasible or unprofitable we need to ask whether the sales market will bring about a more nearly optimal distribution of ownership-operational holdings - that is, whether it will be profitable for the owners of large and relatively unprofitable farms to split them up and sell them to small family farmers. Covariate risk, imperfect intertemporal markets, and policy distortions affecting the functioning of the land sales market will prevent this market from achieving a first-best solution. But increases in efficiency are still likely to result from sales transactions that transfer land from bad to better managers.

Covariate risks and imperfect credit markets

Land is often a preferred store of wealth, so with imperfect inter-temporal markets the utility derived from landownership will exceed the utility derived from farm profits. Its immobility makes land a preferred form of collateral in credit markets which confers additional utility from landownership, especially in an environment where production risk cannot be insured.

The collateral value of land and the high positive correlation of incomes in a given area imply that there would be few land sales in periods of normal weather.[19] Landowners would be made better off by selling land only if they could earn a higher return from the sales proceeds than from cultivating or renting out the land. So, where non-agricultural investment opportunities for rural residents are limited and national credit markets are underdeveloped little land will be supplied for sale in normal years. The number of bidders for land is constrained by the level of household savings since mortgaging the land would be unprofitable. Because land has collateral value, its equilibrium price at given credit costs will always exceed the present discounted value of the income stream produced from the land. Mortgaged land, however, cannot be used as collateral for working capital, so the owner does not reap the production credit advantage and thus will be unable to repay the loan out of increased income from the land. With imperfect insurance markets, only unmortgaged land

[19] Such paucity of land sales is also observed in developed countries where land sales markets are usually very thin. The percentage of farmland transferred on average each year is 3% of the total in the US, 1-1.5% in Britain, 1.5% within the white sector in South Africa, 0.5% in Ireland and Kenya (Moll 1988:354).

yields a flow of income or utility, the present value of which equals the land price. As discussed, if land ownership provides access to credit and helps in risk diffusion, the buyer has to compensate the seller for the utility derived from these services of land (Feder and associates 1988). Since only unmortgaged land provides these services, a buyer relying on credit cannot pay for the land out of agricultural profits alone. Thus land sales are likely to be financed out of household savings, so that the purchased land can be used as collateral for working capital. This need to purchase land out of savings tends to make the distribution of landholdings more unequal, despite the greater utility value of land to smaller owners arising from its insurance value and their lower labor costs.

Spatial covariation in yields suggests that in particularly good crop years, when savings are high, there would be few sellers and many potential buyers of land. Good years are thus not good times for land purchases. In bad crop years, farmers would have little savings with which to finance land purchases. And in particularly bad periods - say after consecutive harvest failures - moneylenders would be the only ones in the local rural economy with assets (their debt claims). Moneylenders would prefer to take over rather than sell the landholdings offered as collateral by defaulters since the price of land would be lower than average in bad years. So, in bad crop years land would be sold mainly to moneylenders as distress sales, or to individuals with incomes or assets from outside the local rural economy. We should expect, then, that in areas with poorly developed insurance and capital markets, land sales would be few and limited mainly to distress sales. Results from India and Bangladesh confirm this hypothesis. Farmers in India experiencing two consecutive drought years have been found to be 150 percent more likely than other farmers to sell their land (Rosenzweig and Wolpin 1985).

The implications of different mechanisms to insure against risk on distress sales and the land ownership distribution are demonstrated by a comparison of the evolution of ownership holdings from about 1960 to 1980 for predominantly agricultural villages in India and Bangladesh (Cain 1981). These villages faced very high environmental risks but were characterized by distinct differences in mechanisms of risk-insurance: In Maharashtra, India, an employment guarantee scheme operated throughout the period and attained participation rates of up to 97 percent of all households during disasters. Such schemes were absent after the major flood episodes in Bangladesh. With other insurance-mechanisms either absent or exhausted, 60 percent of land sales in Bangladesh were undertaken to obtain food and medicine. Downward mobility affected large and small farmers equally,

suggesting that even large farmers had insufficient possibilities to diffuse risks. 60 percent of the currently landless had lost their land since 1960 and the Gini coefficient of landownership distribution increased from 0.6 to almost 0.7. This contrasts sharply with the Indian villages where land sales for consumption purposes accounted only for 14 percent and were incurred mainly by the rich to meet social obligations. 64 percent of land sales were undertaken in order to generate capital for productive investment (digging of wells, purchase of pumpsets, children's education and marriages), leading to an equalization of the land-ownership distribution in India, and suggesting that the poor were not only able to avoid distress sales, but actually could acquire some land as rich households liquidated agricultural assets to be able to pursue non-agricultural investment.

Historically, distress sales have played a major role in the accumulation of land for large manorial estates in China (Shih 1992) and in early Japan (Takekoshi 1967) and for large landlord estates in Punjab (Hamid 1983). The abolition of communal tenure and the associated loss of mechanisms for diversifying risk are among the factors underlying the emergence of large estates in Central America (Brockett 1984).

Moral hazard, covariance of income, and collateral value of land imply absent insurance and imperfect credit markets. In such environments, land sales markets are likely to become a means for large landowners to accumulate more land. Even where markets for labor, current inputs, and land sales and rentals are perfectly competitive, weak intertemporal markets for risk diffusion may therefore prevent land sales markets from bringing about pareto improving trades and an efficient farm size distribution - an illustration of the theorem of the second best.

The impact of policy distortions

The existence of common policy distortions intensifies the failure of the land sales market to distribute land optimally. Consider an idealized case of competitive and undistorted land, labor, risk and credit markets. The value of land for agricultural use would equal the present value of agricultural profits capitalized at the opportunity costs of capital. If the poor have to borrow to buy land at its present value, the only income stream available for consumption is the imputed value of family labor. The remaining profits go to pay for the loan. If the poor can get the same wage in the labor market, they are no better off as landowners than they would be as wage-laborers. And this

example assumes ideal conditions, with the poor paying the same interest rate as most creditworthy borrowers.

Anything that drives the price of land above the capitalized value of the agricultural income stream thus makes it impossible for the poor to buy land without reducing their consumption below the level of their potential earning in the labor market.

The most important factors and distortions are the following:

- With populations growing and urban demand for land increasing, the price of land is expected to appreciate, and some of this real appreciation is capitalized into the current land price. Robinson and associates (1985) find much higher implicit rates of return (cash rents to land values) to farming in predominant agricultural states in the United States than in states where nonagricultural land demand is high. The impact of closeness to urban areas on agricultural land prices is well known. Since these returns are realized only when the property is sold, the only way a poor person could tap into that income stream is by regularly selling off a small parcel of land to pay the interest costs - hardly a feasible option for small landowners.

- In periods of macroeconomic instability, nonagricultural investors may use land as an asset to hedge against inflation, so that an inflation premium is incorporated into the real land price. If expected inflation is fully reflected in interest rates, inflation alone will not affect agricultural land prices (Feldstein 1980). But if inflation is higher than expected interest rates, and if land is perceived to be no riskier than alternative assets, excess demand for land will increase the price of land as a speculative asset. Inflation and changes in real returns on alternative uses of capital are the main factors explaining changes in land prices for the United States (Just and Miranowski 1989). For Iowa, in addition to fundamentals, (the present value of the discounted future income stream), an additive fad term closely associated with expected inflation has a significant impact on land prices (Falk 1991).[20] In a simulation using results of econometric

[20] Although overvaluation due to misperception - bubbles - would lead to observationally equivalent predictions, myopic behavior on the part of land purchasers seems a more satisfactory explanation. On the possibilities for rational bubbles see Asako (1991) and Diba and Grossman (1988). Empirical and experimental evidence on bubbles is provided buy DeLong and Shleifer (1991), Smith and associated (1988), and Evans (1986).

estimation for Brazil (1966-89) Brandao and Rezende (1992) find that six percent of the increase in land is attributable to credit subsidies, 28 percent to macroeconomic instability (inflation).

- Credit subsidies are capitalized into land values, as shown in the Brandao and Rezenda (1992) study and by Feder and Associates (1988). For the U.S., Shalit and Schmitz (1982), show that most of the increasing debt on farm real estate during 1950-78 was translated into higher land prices, whereas farm income increases had a much smaller impact.[21] Even where there are no credit subsidies, large landowners have a transactions cost advantage in securing credit, which is capitalized into land values and may even block access to mortgage credit altogether for small borrowers altogether.

- Many countries exempt agricultural income from income tax, and even where there is no general exemption, agricultural income is de facto subject to lower tax rates. These preferences will be partly or fully capitalized into land values. Since the poor, pay no taxes and so cannot benefit from the tax break, they do not receive the corresponding income stream. Any other subsidies or tax preferences for large farms similarly increase the difficulty the poor have in buying land.

Where any of these factors push the price of land above the price justified by the fundamentals of expected agricultural profits in the absence of distortions associated with farm size, the poor have difficulty buying land. Even if they are provided with credit on market terms that difficulty persists unless their productivity advantage from lower supervision cost is very large. Of these factors, nonagricultural demand, inflation, credit constraints, and credit subsidies have been investigated empirically; income tax preferences for agriculture have not. Most of the empirical studies concentrate on the United States since the paucity of land transactions in developing countries

[21] While this demonstrates the significance of the policy and institutional environment in aggregate models, microeconomic evidence on the importance of credit rationing on land prices is limited. Carter (1989), Carter and Kalfayan (1989), and Carter and Wiebe (1990) use a roughly calibrated model to determine the reservation price of land as a function of farm-size and obtain a U-shaped curve. Because of the roughness of their data, the results indicate orders of magnitude rather than exact figures, but they are certainly in the appropriate direction.

makes research difficult (Melichar; four other studies; Hallan et al; Barhema). More work needs to be done.

6. Incentives, land-credit links and land rental markets

As long as there are imperfections and/or distortions in other markets, land sales markets are unlikely to bring a skewed distribution of land ownership holdings closer to an optimal distribution of operational holdings. The question, then, is whether land rental markets can increase efficiency by improving the access of the poor to land under conditions in which they can not buy land.

Land tenancy markets might not increase efficiency if tenants lack incentives to invest in land improvements, to work hard, or to apply sufficient inputs. These problems will be particularly severe under sharecropping arrangements, with the tenant receiving only a share of the marginal product of the inputs (the Marshallian inefficiency). Quantitative measurement of the inefficiency associated with share contracts in different environments is necessary to determine the importance of such disincentives. The empirical discussion shows that the inefficiencies of share-cropping, measured at the farm level, are not large.

Despite the disincentives associated with tenancy and sharecropping their widespread use all over the world suggests that, in an environment, where capital constraints and risk considerations make fixed rent tenancy contracts infeasible, share rental contracts may in fact emerge as efficiency enhancing, especially if the incentive problems associated with them are low. Since both the theoretical literature (Otsuka and Hayami 1988; Otsuka, Chuma, and Hayami 1992) and the empirical literature (Bell 1988) have been reviewed recently, the discussion here is brief.

Choice of contract and the incentive problem

In the basic model of land-leasing, renting out land under a fixed-rent or share contract or employing wage labor are substitutes along a continuum on contractual choices (Otsuka, Chuma and Hayami 1992). The landlord maximizes income by choosing the number of tenants, the fixed

payment and the output-share parameter subject to the constraint that tenants achieve their (exogenously given) reservation utility. The tenant determines the level of effort that will maximize utility, yielding an effort-reaction function.

The basic model consists of a constant returns to scale production function $Q = \theta F(e,h)$ where Q is output, e is effort, h is number of tenants, and θ is a stochastic element. The landlord's income is $y = h[1-\alpha)Q - \beta]$, and the representative tenant's income is $Y=\alpha Q + \beta$. The fixed rent contract is obtained for $\{\alpha=1,\beta<0\}$, the pure wage contract for $\{\alpha=0,\beta>0\}$; and $\{0<\alpha<1\{$ with arbitrary β (often assumed to equal zero for simplicity) characterizes the share contract (Otsuka and Hayami 1988).

Under conditions of certainty and the rather unrealistic assumption of perfect enforceability of effort, all contracts lead to equivalent outcomes and the choice of contract type does not matter (Cheung 1967). If the assumption of perfect effort enforceability is dropped, the tenant receives only a fraction α of their marginal product for all but the pure cash rental contract. Therefore, with effort unobservable and under conditions of certainty (or equivalent, risk neutrality), the fixed-rent contract clearly dominates the fixed-wage and the share contracts and will always be chosen in equilibrium (Otsuka, Chuma, and Hayami 1992). Given supervision costs for workers or sharecroppers any type of contract other than fixed rent would result in an undersupply of effort by the tenant or worker, which would lead to lower total production.

With risk aversion and uncertainty, a share contract provides the possibility of partly insuring the tenant against fluctuations in output. Where intertemporal markets are weak or unavailable, there would then be a trade-off between the risk-sharing properties of the fixed-wage contract under which the worker's residual risk is zero, and the incentive effects of the fixed-rent contract, which is associated with the optimal supply of effort. (Note that with effort as the only variable input, effort supply completely determines total production.) Under these empirically relevant conditions of risk aversion and uncertainty, the one-period contract can achieve only a second-best solution since increases in the output share parameter above the second-best equilibrium value, while increasing expected production, are no longer Pareto superior since they lower the risk-averse tenant's utility by exposing him to greater uncertainty.

Recasting the problem in a multiperiod context and allowing for reputation effects, however, provides options for bringing this second-best optimum closer to the first-best outcome. Otsuka, Chuma, and Hayami (1992) discuss the conditions under which, in a multiperiod context, the threat of loss of reputation will prevent the landlord from cheating, and so the fixed-rent contract will tend to dominate the fixed-wage contract as it does in the certainty case just described. They argue that in relatively closed villages, such implicit enforcement by the community may be strong enough to bring the inefficient outcome under the unenforceable contract closer to the first-best outcome even if risk is present. This conclusion is consistent with the empirical observation that fixed-wage contracts are found only where the institutional environment discriminates against tenancy contracts (see section 3 and below) but is inconsistent with the overwhelming prevalence of share-cropping relative to fixed-rent tenancies.

Choice of contracts and factor market constraints

There is considerable theoretical justification and evidence (Bliss and Stern 1982; Pant 1983; Nabi 1985; Binswanger and Rosenzweig 1986; Skoufias 1991; Shaban 1991) that where markets for lumpy inputs such as management skills and draft animals are imperfect, households seek to achieve the optimal operational holding size through land tenancy contracts. Given the nontradable factor endowment, land rental would be expected to increase efficiency if a fixed-rent contract is chosen. The relevant question is whether share contracts would increase efficiency as well.

A limit on the working capital available to the tenant (or to landlord and tenant) because of imperfection in the credit market, can lead to the adoption of a share contract as the optimal solution to the bargaining problem. Laffont and Matoussi (1981) show that a working capital constraint imposes limits on the share parameter α that may make the first-best fixed-rent contract unfeasible. Their model implies positive correlation between the tenants' working capital and his output share α. A positive correlation between working capital and output in the share contract but the absence of such an effect in the fixed rent contract would indicate presence of an incentive problem. Consideration of the joint working capital available to tenant and landlord does imply a negative relationship between the landlord's working capital and the tenant's share. All of these predictions are confirmed empirically for a set of data from Tunisia. This direct dependence of the optimal choice of contract on the working capital available to both landlord and tenant may account

for the coexistence of a variety of contracts in the same environment among parties with roughly similar risk aversion but different endowments of working capital.

Thus the main reason that *interlinked contracts* and cost-sharing arrangements are so common may be that they implicitly provide the credit or insurance a tenant needs in an environment where credit and insurance markets are imperfect (Otsuka, Chuma and Hayami 1992). The traditional interpretation that these interlinkages are devices used by landlords to bring the second-best equilibrium closer to the first-best outcome by increasing the tenant's supply of effort (Braverman and Stiglitz 1982; Mitra 1983; Braverman and Srinivasan 1981) requires strong assumptions that are generally not satisfied in developing countries (Otsuka, Chuma, and Hayami 1992).

A tenant may be able to meet only part of his (working) capital requirements in the credit market because of the limited suitability of unharvested crops as collateral - and at higher interest rates than the landlord would get by offering land as collateral. The landlord is in a better position than other financial intermediaries to provide a tenant with implicit credit and actuarially fair insurance because of economies of scope in supervision and informational advantages concerning the value of the tenant's unharvested crop. Since the amount of credit provided will be related to the tenant's expected future income, the landlord can set the contractual fixed payment to zero and still be free to adjust the interest rate, or accept the customary interest rate and adjust the fixed payment and share parameter, to realize an optimal outcome (Otsuka, Chuma, and Hayami 1992).

A popular form of implicit credit is the landlord's provision of inputs to the tenant under a *cost-sharing arrangement*. Providing inputs this way is formally identical to an implicit production loan which, like interlinked contracts, would be adopted where credit markets are imperfect. Static analysis of cost-sharing arrangements may thus be inappropriate if credit constraints are to be taken fully into account. Calculating the implicit interest rate charged for such production loans would help determine the equity and efficiency consequences of share-cropping arrangements. The few empirical studies that have been done suggest that the interest rates may not be significantly different from those charged by moneylenders, rates reaching as high as 50 percent (Fujimoto 1986) or even more (Morooka and Hayami 1986). Where there are imperfections in credit markets, it is possible to derive the precise conditions for share contracts under which the benefits from overcoming the credit

market imperfections would be greater than the loss resulting from the Marshallian inefficiency (Shaban 1991).

If tenants are assumed to be willing to bear greater risk as their wealth rises (decreasing absolute risk aversion) then both working capital constraint with imperfect credit markets and risk aversion by tenants would generate observationally equivalent outcomes. For a sample of Tunisian farmers, Laffont and Matoussi (1988) found that a credit constraint rather than risk aversion led farmers to prefer share over fixed-rent contracts. Since credit and insurance are at least partly substitutable, it is likely that improvements in financial markets and in the insurability of risk will lead to a decrease in share contracts in favor of fixed rent contracts. Such a shift should result in a gain in overall efficiency since fixed-rent contracts have superior incentive properties.

None of the land rental models discussed here, or even Marxian-inspired models of semifeudalism (Bhaduri's 1986) considers the tenant's reservation utility - usually the market wage - to be endogenously determined. Instead they explain inefficiency and inequities as consequences of the contracts themselves, despite the fact that such contracts are entered voluntarily by both parties (see epilogue). But in light of the discussion in section 2, it would be surprising indeed if landlords with some political power did not try to find ways to reduce the reservation utility of potential tenants and workers.

Governments the world over have been concerned about the efficiency and distributional implications of such tenancy arrangements, which in essence depend on the relative bargaining power of each of the contracting partners. Tenancy and sharecropping have therefore been heavily regulated. The empirical evidence suggests that government interventions into these have had little success in achieving their stated objective of protecting tenants, which is hardly surprising given the market imperfections leading to the emergence of share tenancy, and the design difficulty to welfare-improving interventions. Historically, land reform that resulted in establishing owner-operated farms appears to have been a far more successful way of addressing the equity question.

Evidence on efficiency of tenancy arrangements

and draft animals were significantly lower on sharecropped plots than on owned parcels. No statistically significant differences in efficiency were found between owned plots and plots rented on a fixed-rent basis, supporting the hypothesis of the productive efficiency of fixed-rent contracts. Other results point in the same direction (Sen 1981), and Otsuka and Hayami's (1988) review of the literature finds, at most, small efficiency losses associated with tenancy.

Government interventions have given rise to efficiency-reducing share contracts in a number of countries. Otsuka, Chuma, and Hayami (1992) argue that in India, where the Bell and Shaban studies were conducted, there were a number of government constraints on long-term fixed rent contracts. That implies that the 16 percent in production losses adjusted for land quality derived by Shaban are likely to constitute an upper bound.

Land transactions to circumvent imperfections in credit markets have been important in West Africa in the past (Robertson 1985), and continue to be observed in a number of developing countries where credit markets are absent or credit is highly rationed. Usufruct mortgage is still reported to be common in Bangladesh (Cain 1981), Java (Morooka and Hayami 1986), and Thailand (Fujimoto 1988). In the Philippines, tenancy transactions emerged as a credit substitute in response to limitations on the transferability of land (Nagarajan and associates, 1991).

Where there is imperfect information, on tenants' unobservable characteristics, landlords may interpret the tenants' acceptance of certain types of contracts as a signal that can be used as a self- selecting screening device (Newberry and Stiglitz 1979). The preference for tenants who already possess some land and draft animals, which is well documented in the literature (Quibria and Rashid 1986; Shaban 1991) points in the same direction.

Tenancy has often been described as a rung on the "agricultural ladder" that rises from worker to share tenant, to fixed rate tenant, to owner and permits farmers to acquire capital and agricultural knowledge. In a static framework this has been modeled by making production a function of tenants' effort and the landlord's provision of management skills (Eswaran and Kotwal 1985). Although quantitative evidence is limited, Reid (1973) argues that this function of tenancy played an important role in the U.S. South after the abolition of slavery. Lehman (1986) noted the importance of tenancy in facilitating capital accumulation in the intergenerational transfer of farm holdings in

Ecuador. Tenancy would be expected to facilitate capital accumulation where land is abundant relative to labor and where rents or owners' shares are low. Longitudinal studies of changes in tenancy patterns and capital accumulation over the life cycle of tenants would help shed more light on the relative importance of this phenomenon in different environments.

Conclusion

Because of the productivity advantage of small over large farms, it is more profitable for large landowners to rent out land under fixed-rent contracts than to work it using hired labor, if markets and information are perfect. If effort is unobservable and credit is rationed or insurance markets are imperfect and tenants risk averse, the first best fixed-rate tenancy contract may no longer be attainable and a second-best share contract would be adopted instead.

Empirical investigations show that share tenancy arrangements under a wide variety of conditions are a highly flexible tool for adjusting to such constraints with relatively modest losses. Since effort is not fully enforceable and even limited enforcement is likely to be associated with some cost, the adoption of share tenancy (or wage labor) contracts would still be associated with some loss of efficiency. Removing the conditions that prompt the emergence of share tenancy are likely to lead to modest efficiency gains and will be more effective than legal prohibition of such contracts (see Part III). Greater efficiency gains may be associated with the removal of the distortions that lead to the adoption and perpetration of wage labor contracts, and large commercial farms rather than fixed-rent or share contracts.

PART III: LAND POLICY

Many institutional arrangements in land markets emerge as a result of attempts by the contracting parties to overcome problems of asymmetric information, moral hazard, and covariance of risk. Other types of institutional arrangements represent interventions by the government or community intended to produce outcomes that are more congruent with the society's objectives than those that would be generated by market forces alone. Here, we will define efficiency and equity as the main objectives underlying interventions in land markets, although equity can be considered a tool

for achieving the more encompassing objective of minimizing social tensions. The two objectives are not always compatible; in some situations interventions that facilitate greater equity would reduce efficiency, and vice versa. But not always.

Four broad types of land distribution and production relations remain today (figure 1), each with its own characteristic policy problems. Family farm systems under freehold or communal tenure face problems of access to credit, land registration and titling, tenancy regulation, fragmentation, and taxation. Communities in which communal tenure prevails face decisions about allowing sales to outsiders. Where large scale mechanized commercial farms coexist with low wages and unemployment, governments have to consider ways, such as the elimination of tenancy regulation, the elimination of agricultural subsidies and/or land reform, to make farm size distributions more compatible with equity and efficiency objectives. In wage plantation systems, contract farming and taxation are the important issues. For collective and state farms systems the key concern is whether decollectivization or privatization should aim to establish large commercial farms or small family farms.

7. Land registration and titling

The issues

Land titles an registration reduce the problems of asymmetric information and thus provide the institutional framework to facilitate land sales. Such transfers can enhance efficiency by transferring land from bad managers to better farmers and by facilitating the use of land as collateral in the credit market. Transfers of land, which are facilitated by land titles may negatively impact equity as well as efficiency if economic and institutional distortions encourages accumulation of land by influential or wealthy individuals. As establishment and maintenance of land titles is not costless, whether to introduce titling has to be based on a comparison of the benefits of land titles over and above existing arrangements to regulate land transactions and the likely cost of such arrangements.

In the early stages of agricultural development, transactions in land take place mainly among individuals who are members of the same community and who generally share information about the

rights enjoyed by a renter or a seller, and about rights to specific tracts of land. With more advanced agriculture and increased mobility, communal constraints on sales to outsiders are abandoned and transactions are increasingly with individuals who are not members of the same community. The scope for asymmetric information increases, generating inefficiencies in the land market since the price of land may no longer reflect its true social value and the extent of land transactions becomes less than optimal. To reduce these informational inefficiencies and the associated welfare losses, societies develop institutional arrangements to reduce risk, such as the requirement in the Arthsastra (4th Century B.C. in India) that land transactions be conducted in public with witnesses or the establishment of a centralized public register that tracks land plots and those who have rights over these plots. As early as 600 B.C., the Bible describes a land transaction between the prophet Jeremiah and a relative in which a written record of the transaction was kept in two copies with a certain priest in Jerusalem.

Public registers provide potential buyers or renters of land with a way to verify that the rights they are about to purchase belong to the seller. A functioning legal system and effective enforcement mechanisms are other institutional arrangements designed to reduce the uncertainty related to land transactions. Without such arrangements to reduce the risk of challenges to land rights, the incentives to invest and to work hard are weakened. It is often more efficient to reduce the risk through the provision of public goods (land records, police, judiciary), than trough the private individual allocation of resources (guards, elaborate fences).[23]

Asymmetric information and risk are at their extremes in frontier areas, where specific plots have no previous owners, though the government usually claims formal ownership. While often the land is subject to a general claim by tribal groups who have been using it for hunting, gathering, horticulture or livestock grazing, some of it is also claimed by individuals who have migrated from other areas. Since there is no culturally unified community from which to obtain knowledge, the administrative infrastructure (land record, offices, courts, police) typically becomes overloaded by claims and counter claims. It is not uncommon then to find private (and necessarily segmented) institutions protecting property rights over land (gunmen, fortified property). And because the

[23] In Uganda and Côte d'Ivoire, land privatization significantly decreased risks and transaction costs associated with transferring land resulting in increased land transfers, a factor commonly associated with higher productivity in agriculture (Barrows and Roth 1990; Atwood 1990).

institutions for recording property are not well developed, land claims based on forest clearing can lead to excessive deforestation (Southgate, Sierra and Brown 1991).

Institutional arrangements for land records and title documents also have beneficial implications for credit markets. In lending, asymmetric information provides ample scope for moral hazard. Collateral has long served as a means of minimizing the efficiency losses associated with asymmetric information and moral hazard and land has traditionally been viewed as an ideal collateral asset in areas where land is scarce (Binswanger and Rosenzweig 1986). For land to be useful as collateral, however, the lender needs to be assured that the borrower-operator has the right to dispose of the land by sale or the transfer of use rights. Thus the documentation of land rights makes land a form of credible collateral, affects the willingness of lenders to make loans and may make credit markets more efficient (Feder, Onchan, and Raparla, 1988). Where the inability to use untitled land as collateral for credit is the relevant constraint, the issuance of titles can provide a solution in the long term. But other constraints such as small farm size prevent the operation of a credit markets, land titles may fail to be useful until these obstacles are not removed (Atwood 1990).

Under ideal conditions government intervention in land registration is theoretically neutral in its effect on equity. In practice, however, titling can lead to greater concentration of land and to the dispossession of groups that have enjoyed land rights under a customary system that predated the formal system. When titling is introduced, wealthier and better connected individuals may use their information advantages to claim land over which other, less informed, individuals have customary rights. Even when there are no information advantages, titling based on the on-demand principle involves fixed and relatively high transaction costs for surveys and bureaucratic processing that put smallholders at a disadvantage. The equity-reducing impacts of titling on this basis are well-known. The introduction of selective titling on demand greatly facilitated the emergency of haciendas in Central Luzon (Hayami and Kikuchi 1984), Guatemala (Cambranes 1985), El Salvador (Lindo-Fuentes 1990), and Nicaragua (Newson 1987). In Bolivia during the 1980s, the titling agency granted titles to very large farms in the Eastern Lowlands within one to two years, while applications from smallholders without the benefit of helpful lawyers have an average processing time of 12 years. Bruce (1988) notes that land grabbing by influential individuals during titling programs who are able to use the rules in their favor did more to facilitate land concentration than transactions in the land market following the issuance of titles. The profitability of consolidating several small untitled

holdings and getting a single title provides incentives for wealthy individuals to buy out smallholders and to concentrate their own holdings. Titled land also provides advantages in the credit market (Feder, Onchan and Raparla 1988) that are likely to increase income disparity.

The policy implications

To avoid these undesirable effects, titling programs should be accompanied by publicity campaigns to ensure widespread knowledge of the rules and procedures. Both equity and efficiency considerations argue that titling programs by systematic rather than on demand. Efficiency is increased through economies of scale and equity by the fact that *all* claims in an area are registered at the same time. The *ryotwari* system introduced by the British system in Southern India around 1820 and similar systematic titling programs elsewhere show that conflicting claims can be dealt with through a relatively quick administrative procedure rather than through lengthy and costly legal channels.

Because titling programs can be expensive, the issue of optimal expenditure is relevant (see Malik and Schwab 1991). Feder and Feeny (1992) have demonstrated that when individual willingness to pay for titling determines the aggregate public expenditure, there may be a tendency for over-investment from a social welfare perspective. Frequently, some less costly arrangement than formal titling may significantly lessen the problem of asymmetry of information. In Rwanda, the local municipality issues affidavits that attest to he ownership rights of specific individuals over specific tracts of land but are not based on precise surveys (Blarel and associates 1992). A lower cost system was also used in Thailand prior to the introduction of formal titling (Siamwalla et. al. 1990, Feeney 1988).

Communal systems constitute a special case. Communal land is not considered adequate collateral in formal credit systems because of constraints on sales to outsiders. Issuing individual titles in communities that maintain such constraints may improve neither the security if tenure nor access to credit, although individual titles would be helpful to avoid barriers to the emergence of rental markets within the community. Until the restrictions on transfers to outsiders are eliminated, a community title could be issued to ensure the community's security of ownership against well-connected outsiders. Platteau (1992) advocates registering land as "corporate property" as a way of decreasing the costs

associated with titling while reaping many related benefits such as insurance, flexibility of land allocation, and the utilization of genuine scale economies in subsidiary activities. Experience with group ranches in Kenya suggests that imposing group titles from above is unlikely to be successful while issuing individual titles does not prevent farmers from taking advantage of scale where they exist (Grandin 1989).

Another case for community titles concerns common property resources, such as communal pastures, forests, or other marginal lands. Such areas constitute an important safety net for the poor that may be particularly important in high-risk environments where alternative means of insurance are unavailable. Community mechanisms for managing common property resources have tended to weaken with economic development (Lawry 1991; Jodha 1986 and 1990), and privatization of such resources in India has led to significant increases in yields. But the preservation of common property resources could be desirable from an equity perspective since privatizing these lands takes away a part of the social safety net for the rural poor. Providing a community title for these lands can protect communal rights from outside encroachment and prevent the poor from being excluded from communal property. We need to learn more about the management and the relative importance of such areas to specific social groups.

Assessments of the impact of individual titling on efficiency vary. Atwood emphasizes that in a distorted environment, introduction of land titles may decrease equity and efficiency. Feder, Onchan, and Raparla (1988) find that in Thailand, where possession of a title can be considered exogenous[24] output is 14 to 25 percent higher on titled land than on untitled land of equal quality. The market value is also much higher for titled land than for untitled land of similar quality. Less rigorous evidence is provided for Costa Rica by Salas and associates (1970), who estimate a positive correlation of .53 between farm income and title security. Studies in Brazil and Ecuador also suggest a positive association between farm income and titles (IDB 1986). But several studies have demonstrated that the credit market advantages of titles account for the lion's share of their effects and that ownership security does not significantly affect demand for titling (Adholla and associated 1991). Titling may have no significant effect at all when legal or customary rules limit land

[24] If the decision to acquire title is endogenous, estimation of the effects of titling using cross-sectional data is subject to simultaneity bias (Boldt 1989; Stanfield 1990).

transactions and credit markets are weak. In Latin America where credit markets are more developed, recent land titling programs appear generally to have led to increases in the value of land, without encouraging increased concentration - at least in the short term - (Stanfield 1990).

8. Land Tax

The issues

In most developing countries, land taxes have evolved from tribute payments to feudal lords or to a colonizing power. Because the taxes went to central government budgets, local willingness to pay depended on strong enforcement by tax collectors, who shared in the revenues. Inflation and the difficulty of centralized collection eventually led to the erosion or complete disappearance of such taxes. Today, the policy question is whether to reinstate land taxes and, perhaps to use them to finance investments and serviced in local jurisdictions, as is done successfully in the United States. In theory, a tax on land has three main advantages over a tax on agricultural output or exports: (1) if a land tax is based on the potential monetary yield of a certain plot under normal conditions, a land tax has minimal disincentive effects; (2) it facilitates taxation of the domestic agricultural sector while being much less regressive than poll taxes; and (3) if the tax basis is changed infrequently, a land tax does not discourage investment in land improvements.

If risk is high and insurance markets are unavailable or imperfect, introducing a significant land tax (based on average incomes) can lead to increasing land concentration as Hamid (1983) has shown for India. Under these conditions, a tax based on actual output, which acts as an insurance mechanism in the same way as sharecropping does, might be preferable to a lump-sum tax on land (Hoff 1991). It can be shown, however, that for realistic values of risk aversion, income variation, and export taxes, producers would prefer a land tax, balanced by an equivalent reduction of export taxes (Skinner 1991).

Administering a tax on land effectively and equitably requires having an official record, or cadastre, of the size, value, and ownership status of each tract of land, its productive capacity and information on the costs of outputs and inputs. Land tax administration also requires a property tax law that assigns property rights and tax obligations and an administrative organization that keeps the register up to date and assess, collects, and enforces the tax (Bird 1974). Even in the few developing countries able to meet these conditions, land taxes are relatively unimportant, suggesting that the administrative or political costs may be higher than the incentive advantages associated with a land tax.

Progressive land taxes are often advocated as a means of making land speculation less attractive and inducing large landowners to sell out or use their land more intensively (see Hayami, Quisumbing, and Adriano 1991 on the Philippines). Landowners often find ways around such taxes, however, from establishing dummy divisions of their holdings to lobbying for exemptions from progressive rates associated with effective use of the land (as in Brazil), which sharply diminish the effectiveness of progressive land taxes in breaking up large commercial farms. Such an approach was applied and failed in Argentina, Bangladesh, Brazil, Colombia, and Jamaica (Strasma, Alsm, and Woldstein 1987; Bird 1974); Carter (1992) in a simulation model calibrated to Nicaragua finds that a progressive land tax is unlikely to significantly alter the distribution of land. And even if such taxes did work, it is not obvious why such an indirect approach would be politically more acceptable than direct redistribution of land. Progressive land taxes are also likely to be associated with higher administrative costs and protracted litigation.

Policy implications

Where the administrative requirements - an up-to-date cadastre plus administrative organization - are lacking, flat or mildly progressive land taxes based on rough classification of holdings may still be useful for raising revenue and providing some modest incentives for owners to sell off poorly utilized land. The United States has found success by assigning the administration of land taxes to local authorities and earmarking tax revenues for local infrastructure and local government services. By increasing the local visibility of the benefits financed with the tax revenue, this approach may increase willingness to pay a land tax. It may also reduce administrative costs since local governments should be better able to assess land values and land ownership.

9. Regulations limiting land sales

Governments and local authorities have often placed restrictions on land transactions. Restrictions are typically placed on land sales and rentals when major changes are introduced to alter the land ownership pattern (redistributive land reform or settling programs). The restrictions are designed to prevent an increase in the number of landless and in the social tensions that accompany landlessness. Since these restrictions also prevent some transfers of land from worse to better farmers

or managers, there is likely to be some efficiency loss. Such restrictions are frequently evaded, however, through disguised sales and rentals, which are likely to involve transaction costs that constitute a loss to society.

Restrictions on the rights of land reform beneficiaries or settlers on state-owned land to sell the land also reduce their access to credit. Often new owners are forbidden to mortgage their land during an initial probation period. Since that period coincides with the establishment phase, when their need for credit is most urgent, the efficiency losses may be considerable. Land rental contracts (usufruct-mortgaging and *kasugpong* contracts) that have arisen as credit substitutes, in some places, such as the Philippines (Nagarajan, Quisumbing and Otsuka 1991) involve considerable efficiency losses.

Sometimes restrictions on sales are not total, as in communal systems that permit sales only among members of the community. The welfare losses from the sales restrictions are less than in the case of a total ban, but they are not completely eliminated.

In the early years after a redistributive land reform in areas where land markets are thin and accurate information may not be available on the expected stream of incomes from the land, it may be reasonable to impose a temporary restriction on sales of say, three to four years. That would allow sufficient time to acquire knowledge about a farm's potential and to avoid sales at prices below the real value of the land, which would run counter to efficiency and equity objectives. Such restrictions would not be needed, however, in areas where former tenants receive land they have been tilling since they can be assumed to have adequate knowledge of the land. In the case of partial restrictions under communal systems, the ban on sales to outsiders may serve a protective role in environments where outsiders with strong political connections may attempt to take over land in the community. Where appropriate institutions for intragroup decision-making are available (Libecap 1986), permitting the community to limit sales and giving it the right to decide whether to eventually allow sales to outsiders may be an acceptable compromise between equity and efficiency concerns (see Barrows and Roth 1990). As traditional social ties loosen or the efficiency loss from the sales restriction becomes too high, groups are likely to allow sales to outsiders. The recent constitutional reform of the land rights system in Mexico allows for free sales and rental within all *ejidos* and for decision-making by majority vote on whether to eliminate the restriction on sales to outsiders.

The most common means of restricting land sales are upper and lower bound size restrictions and zoning regulations. *Land ownership ceilings* have often been imposed in an attempt to break up large estates or to prevent their reconcentration. Among countries that have imposed ceiling are Bangladesh (Abdullah 1974), India (King 1977), Indonesia, Japan, Korea, Pakistan, South Vietnam, Taiwan, Egypt, Ethiopia, Iran, Iraq, Zimbabwe, Bolivia, Cuba, El Salvador, Guatemala, Mexico, and Peru. While such ceilings can theoretically increase efficiency where a negative relationship exists between size and productivity, in practice the ceilings have been evaded through fictitious subdivisions or have become superfluous over time through inheritance. Ceilings were often commodity specific providing much larger limits for sugarcane, bananas or livestock ranching. Therefore, they encouraged inefficient conversion to products with the highest ceilings. Rarely did ceilings alone enable the poor landless or extremely small farmers to purchase land; rather, they enabled farmers with medium-sized holdings, who had already acquired some equity, to enlarge their holdings (Chile).

Despite these flaws and loopholes in practice, several studies do credit land ownership ceilings with a major role in preventing new large consolidations after land reform (Cain 1981; Mahmood 1990). In Japan and Korea, success in preventing the reaggregation of land may be attributed as much to the availability of attractive investment opportunities outside agriculture and to noneconomic factors such as attachment to land as to the ceilings on land holdings. Ceilings imposed following a land reform that results in fairly homogenous holdings might be effective and less distortionary in preventing massive reconcentration of land.

At the opposite end, *restrictions on minimum holding size* are intended to prevent excessive fragmentation of farms. While it is not clear that fragmentation is always a negative phenomenon (see below) a floor on farm size might provide a useful countervailing effect in a society where inheritance customs lead to extremely small farms. Whether the intervention improves efficiency depends on the specific circumstances. Also to be considered is that many restrictions on subdivision of land or minimum holding size have historically been used to prevent ex-slaves, tenants, and other powerless groups from acquiring ownership rights to land and thus eventually competing with farms established by the ruling group. Restrictions on the subdivisions of large farms in Kenya and Zimbabwe have limited the prospects for land resettlement schemes (Leys 1974) and in these circumstances clearly reduced efficiency.

Governments often adopt *zoning regulations, i.e.* assign specific uses to certain lands to overcome environmental externalities rather than allowing market forces to determine land usage. In urban areas, the objective of zoning is to prevent commercial or industrial activities from locating in residential areas and creating noise and pollution. In rural areas zoning of land for agricultural use provides benefits such as tax credits, exemption from assessments for urban type services, eligibility for soil conservation programs, and protection from nuisance suits, but forecloses the option of selling the land as a residential property.[25] In general, zoning is justified if negative externalities need to be reduced by more than the cost of zoning enforcement.

Zoning laws established for social or environmental reasons may run counter to economic incentives. Zoning may then need to be supported by some type of incentive mechanism, and political support for implementation of the regulations becomes essential to their enforcement (Barrows and Neuman 1990). If there are sharp conflicts between private profitability of land uses and zoning regulations in a country with weak institutional infrastructure, and little popular support for the zoning measures, zoning may lead to excessive rent-seeking and corruption. If zoning results in the emergence of extensive rent-seeking the benefits may greatly decrease or even become negative (Mills 1989). Zoning laws affect supply and demand for land and may lead to consumer mobility in response to zoning (Tiebout effects). The attempt to counteract production or agglomeration externalities through zoning laws also generates the potential for rent seeking behavior by landowners who either try to evade existing zoning regulations or lobby for the imposition of a set of laws which would provide them with a differential advantage. All of these issues have been analyzed largely in isolation of each other and a comprehensive analytical treatment is not yet available (Pogodzinski and Sass 1990).

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[25] Henneberry and Barrows (1990) find that parcel characteristics in general determine whether agricultural zoning has positive or negative price effects, in particular parcel size and distance from urban areas. (For a review of the effects of urbanization on agriculture, see Bhadra and Brandao 1992.)

10. Fragmentation and consolidation

The issues

While governments often intervene to prevent fragmentation of farm land, such intervention is not always economically justified. That requires that inheritance customs or other exogenous forces be responsible for most of the fragmentation, that losses from fragmentation be substantial, and that existing markets be unable to counter fragmentation.

While inheritance customs probably explain much of the fragmentation of farm land, it may also reflect conscious decisions by farmers seeking to reduce their risk by diversifying their farm land and thus their crops (McCloskey 1975). This factor is likely to be important where other risk-diffusion mechanisms such as insurance, storage, or credit are unavailable or are associated with higher costs than fragmentation. Fragmentation may also help to smooth out labor requirements over time where labor requirements are highly seasonal (Fenoaltea 1976).

Among the disadvantages associated with fragmentation are physical problems (increased labor time, land loss, need for fencing, transportation costs, and limitations to access); operational difficulties (unsuitability of certain equipment, greater difficulty with pest control and management and supervision, foregone improvements such as irrigation, drainage, and soil conservation); and social externalities (need for extensive road and irrigation networks; Simons 1987). The few studies which quantify losses from fragmentation in developing countries suggest that the losses involved are modest, although further studies of the efficiency of farms or losses from fragmentation are clearly needed. Indeed, Heston and Kumar claim that in Asia "it is hard to find instances where fragmentation had involved high losses in output" (1983:211), and in Ghana and Rwanda, Blarel and associates (1992) find fragmentation does not seem to hurt productivity and does improve risk diversification and the allocation of family labor over time.

Policy implications

Relying on the market to eliminate fragmentation is likely to involve high transaction costs to coordinate transfers among large numbers of landowners. Transaction costs are much lower

under government programs, which are normally coercive and include a range of other development initiatives, and returns can be high - Simons (1987) finds returns of 40 percent for France. However, if the forces that led to fragmentation remain unchanged, land consolidation programs are unlikely to have any long-term effect (Simons 1987; Elder 1962).

When should something be done about fragmentation? Experience in industrialized countries shows that fragmentation becomes a serious constraint requiring intervention once it impedes the ability to use machinery on a large scale in areas with a rapidly decreasing agricultural population (Bentley 1987). This is rarely the case in developing countries, with their high population densities. In addition, consolidation programs are likely to take a long time to complete, and they require considerable human capital and well-developed cadastres and land titles. Immediate government action to consolidate holdings does not appear to be a high priority in most developing countries, considering the high costs and the potential reduction of interest in fragmentation as rural credit and insurance markets improve.

11. Restrictions on land rentals

The issues

Governments have often introduced *tenure security and rent control legislation* to protect tenants from arbitrary eviction or to limit the amount of rent landlords can change. The unintended result has often been the eviction of tenants at the first hint of such legislation and the landlords' resumption of self-cultivation on the home farm, resulting eventually in the formation of Junker estates. In India, attempts to provide greater land security for tenants could be enforced only in states that imposed land ownership ceilings (King 1977), and even there, landlords found ways to evade the legislation by signing tenants to short-term contracts which were exempt from protection, or by rotating tenants from plot to plot.

Where rent controls have been effectively implemented and combined with protection from eviction as in the Philippines or Taiwan, they do increase tenants' income, but since there is no transfer of ownership, they are still likely to result in dynamic efficiency losses. In the longer term,

unless landowners find ways to circumvent the restriction on rents, such policies are likely to reduce incentives for renting out land, resulting in efficiency losses from constraints on adjustments in operational farm sizes. Investment is also likely to fall on farms on which tenants have a protected status since landlords are unlikely to invest heavily in land from which they are prevented from evicting tenants while tenants' incentives to invest are weakened by uncertainty about the inheritability of the protected status.

Bans on share tenancy or low ceilings on the landlord's share are widespread even where other forms of land rental are allowed, such as the Philippines (Otsuka, Chuma and Hayami 1992), Brazil (Estatuta da Tierra 1964), Zimbabwe (Palmer 1979), South Africa (Bundy 1985), Honduras, and Nicaragua (Dorner 1992). These restrictions are motivated in part by the common belief that share tenancy is exploitative (because, under conditions of land scarcity, tenants are likely to receive incomes close to their reservation wage) and in part by efforts to eliminate the Marshallian inefficiency associated with share contracts. But if the choice of contract is endogenous and if share contracts provide efficiency gains under circumstances of credit constraints and high risk and supervision costs, simply prohibiting share contracts without changing the underlying framework of market imperfections is likely to result in very slight gains in efficiency (Otsuka and Hayami 1988). More likely, the bans will be ignored, giving way to disguised transactions or less efficient wage labor contracts that improve neither equity nor efficiency. Tenancy has long been an important transitional stage allowing peasants to accumulate capital and gain agricultural experience, so elimination of sharecropping as a rung on the agrarian ladder will certainly not contribute to equity in the long run. And considerable inefficiency in production may be associated with the absence of sharecropping as an option, especially where restrictions on private ownership of land impede the functioning of fixed-rent markets (Noronha 1985). Collier (1989) estimates static efficiency losses of more than ten percent associated with unavailability of share contracts in Kenya. From all perspectives then, bans on sharecropping and low ceiling on landlord's share have no merit.

12. Redistributive land reform

The issues

Most redistributive land reform is motivated by public concern about the rising tensions brought about by an unequal land distribution. The common pattern is concentration of landownership among relatively few large owners in an economy where labor is abundant and land is scarce. Thus the masses of landless laborers and tenants who derive their livelihoods from agriculture receive relatively less income because their only asset is labor. Redistributive land reform can also increase efficiency, by transferring land from less productive large units to more productive small, family-based units (section 4).[26] Yet, because of other market imperfection, land markets will not typically effect such transformations of ownership patterns. The value of the land to large owners may exceed the discounted sum of agricultural income smallholders can expect to receive despite their productivity advantages from lower supervision costs if there are policy distortions favoring large owners or if the access of small farmers to long-term credit has already been exhausted by mortgage-based land acquisition.

Market values of land are determined in a way that prevents small farmers who lack equity from building up viable farms and improving their standard of living while repaying their land mortgage. Land reform schemes that require payment of the full market value of the land are likely to fail unless special arrangements are made. In the simplest case, beneficiaries soon default and the program ends. Many ambitious land reform programs simply run out of steam because full compensation of old owners at market prices imposes fiscal requirements that the political forces are unwilling to meet - that was the fate of programs in Brazil, the Philippines, and Venezuela. Some programs attempt to avoid this problem by compensating landowners (with bonds) whose real value erodes over time. Not surprisingly, landowners oppose this thinly disguised confiscation, and such programs are politically feasible only in circumstances of political upheaval (Cuba, Japan, Korea, Taiwan or Vietnam). Another approach is to finance land purchases through foreign grants or from internal tax revenues or inflationary monetary expansion - or some combination.

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[26] Under circumstances of extreme poverty and landlessness redistribution of land can also enhance efficiency by improving the nutritional wellbeing and thus the productive capacity of the population (Dasgupta and Ray 1986 and 1987, Moene 1992).

Policy implications

Before any land redistribution program is introduced, the implicit and explicit distortions which drive land prices above the capitalized value of agricultural profits need to be eliminated. Otherwise, small farmers will continue to have an incentive to sell out to larger farmers since the environment would still favor large ownership holdings. In Brazil, the emergence of an agricultural structure dominated by large farms owes much to the policy bias in favor of large farms (Binswanger 1987). The poor must be provided with either the land or a grant to help them buy it to compensate for their lack of equity. Credit to beneficiaries for land purchases can only play a subsidiary role.[27] The macro-economic and political environment also strongly affect the outcome of land reform policies. In Chile, substantial increases in output followed the expropriation and redistribution of almost 20 percent of the total agricultural land in 1964-70, much of it due to the increase in investment induced by the favorable macroeconomic and political conditions (Jarvis 1985, 1989). In contrast, output failed to increase significantly during the decollectivization and breakup into family farms in 1975-83, a period of extremely unfavorable government policies. Not until some of the debts incurred to pay for the land had been forgiven and structural impediments affecting small farmers had been eliminated did the program become fully effective. Removing distortions also lowers the amount of grant assistance needed by small farmers to support their acquisition of land.

The type of manorial estate has a substantial bearing on the gains to be expected from land reform. On landlord estates, would-be beneficiaries are already managing operational units so land reform addresses primarily the equity concerns of society, transferring the entitlement to land rents while leaving operational farm structure largely unchanged. Potential efficiency gains are associated with improved investment incentives and increased security of tenure (section 3). With haciendas, the threat of land reform legislation often leads to the eviction of tenants and reductions in the resident work force. The large commercial farms that result are more difficult to subdivide than landlord estates or haciendas (de Janvry 1981, Castillo and Lehman 1983; de Janvry and Sadoulet

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[27] Organizations such as the Penny Foundation in Guatemala have been able to buy land from owners and distribute it to small farmers with little apparent government subsidies (Forster 1992). These cases usually involve some grant element or subsidy in the credit provided to the smallholders, or the purchase of the land below market prices on account of liabilities of the former owner to government institution or the workers which are forgiven as part of the deal.

1989). Land reforms of Junker estates and large mechanized farms involve major changes in the organization of production. The resident labor force and external workers have little or no independent farming experience, and in many cases, neither the infrastructure nor the investments in physical capital provide an appropriate basis for smallholder cultivation.

The availability of technology and of competitive input and output markets thus becomes a crucial determinant for the potential of land reform to increase efficiency. Appropriate institutional arrangements are needed to ensure access to extension services, credit, and markets. Such institutions are especially important where land reform involves resettling beneficiaries on former Junker estates or large mechanized commercial farms. To reap the efficiency gains of family farming under these conditions seems to require increasing the density of family labor, and that may require resettling landless workers from outside.[28] Reform of these systems is likely to be difficult, but where the alternative to reform is the perpetuation of large economic and social costs, including the possibility of revolt and civil war, the cost of failing to reform may be enormous.

Opinions are divided on redistributive reform of wage plantations in the classic plantation crops: banana, sugar, tea and oil palm. The fact that contract farming in these plantation crops is practiced successfully in many parts of the developing world indicates that converting plantations to contract farming is feasible. Indeed, Hayami, Quisumbing, and Adriano describe the successful conversion of even a banana plantation into a contract farming system in the Philippines, and strongly argue for bringing about more such conversations through a progressive land tax. The efficiency gains from lower supervision costs associated with such a step are likely to be offset, however, because of the genuine economies of scale in plantation crops.

Trying to replace plantations with collectives rather than contract farming has been unsuccessful. In Peru, the failure of collectivized sugar plantations to invest and their increased exploitation of external workers who were denied membership rights led to strikes by collective members that were put down by military intervention. Continuing losses - in part due to falling world

[28] To some extent, credit and other public support can substitute for the advantage of more family labor per hectare. Leys (1978) found for Kenya that there was very little difference in economic performance between high density schemes, with small plots and low public investment, and low density schemes with larger plots and substantial public support.

sugar prices - provoked increased government intervention and the effective transformation of the collectives into state farms (Kay 1992). In Malaysia rubber plantations which had been established on a collective basis were split up and allocated to individual farmers at maturity to ensure proper tapping (Pickett 1988).

13. Decollectivization

The poor performance of collectives and state farms the world over is so obvious that the question facing the liberalizing economies of Eastern Europe and the Commonwealth of Independent States is not whether to privatize but rather how quickly and in what form - as large commercial farms or family farms.

Policy implications

The discussions in this paper imply that four issues appear to be of overriding importance in determining this policy choice:

- The small farm option is viable only if there are competitive input and output markets. Otherwise the land rent and the entrepreneurial rents from agriculture would be captured by the monopolistic output marketers and input suppliers rather than by the new farm owners. Risk diffusion mechanisms also need to be functioning adequately else covariate weather or price shocks can force distress sales by new landowners, who do not have other assets or income streams. Work on creating competitive input and output marketing systems and a viable financial system therefore has to start before large farms are split up into individual landholdings.

- Experience from China, Vietnam, and East Germany shows that inputs and machinery services, which have previously been supplied by the cooperative, are more efficiently provided by private contractors who lease or buy the machinery stock from the cooperative in a competitive process (Nolan 1988, Pingali and Xuan 1992, Pryor 1992). The Chinese experience also suggests that farmers and machinery suppliers respond to the changes in operational holding

size by adopting a difference and generally more efficient pattern of mechanization (Ling 1991). This suggests that the excessive lumpiness of the existing machine stock is not a serious constraint to smaller scale farming.

- Agriculture research, extension, and other production support services take on special importance since many farm workers are likely to lack the skills needed to manage their own farms. Some of the structures that served quasi-governmental functions on collective and state farms particularly by providing education and health services could be retained as well. They might also eventually develop into independent cooperatives for supplying machinery, custom plowing machine rentals or for inputs and possibly credit - all in competition with the private sector (see Nolan 1988; Pryor 1992).

- Where capital skills, technology, infrastructure, or competitive markets for inputs and outputs are lacking, enthusiasm for independent farming may be lacking as well. If only a few entrepreneurs are willing to farm, the resulting farms are then likely to be too large for the cost advantage associated with the use of family labor, and large commercial farms, heavily mechanized or dependent on large numbers of hired workers, will emerge in their stead. Most likely such large farms would continue to press for subsidies, emerge as rent-seekers from the rest of society and, if successful, generate insufficient employment. Therefore, countries may need to find temporary arrangements, including long-term land leases, that will provide a greater number of households with opportunities to acquire the necessary skills needed to allow the emergence of a structure of smaller family farms more consistent with the income and wage levels and rural labor forces that can be expected for these economies in the next few decades.

EPILOGUE ON METHODOLOGY

Scholars of various ideological persuasiveness and methodological commitments have attempted to explain the great variations in land relations over space and over time which have been the topic of this paper. Much of the discordance among these scholars is closely associated with their choice of modeling strategies and assumptions. This epilogue relates the analytical results and the

observed variations in land relations discussed in this paper to the minimum set of assumptions needed to derive the results or explain the variations. We distinguish several levels of assumptions.

Level A assumes self-interested behavior, such as expected utility maximization or other forms of purposive behavior, of all actors, who compete on a level playing field in an environment with risk using voluntary transactions, with symmetrically distributed information and exogenously given endowments of land, capital, and skills. Technology is characterized by constant or diminishing returns to scale. Virtually none of the variations in land relations discussed in this paper can be explained with these assumptions alone.

Level B adds constraints in the credit market or assumes that market is entirely absent. Formal models of surplus value from Marx to the generalized version of Roemer (1982) use this approach to explain capitalist exploitation and the endogenous differentiation of maximizing individual economic agents - who operate in a competitive environment with voluntary transactions - into economic classes as the consequence of differences in their exogenous endowments of physical capital and absent credit markets. Eswaran and Kotwal (1985) apply Roemer's approach to agriculture, imposing in addition constant costs (section 4).

Level C adds asymmetric information, moral hazard, and incentive problems, arriving at the analytical apparatus of agency theory. As Stiglitz (1986) summarizes, these assumptions are sufficient to explain credit rationing, thereby giving an analytical underpinning to level B models. They also explain various combinations of reasons for sharecropping and interlinked credit (section 6). These assumptions are also sufficient to establish the superiority of family farms, as discussed in the mathematical model of Feder (section 4 and appendix 2) and the historically widespread use of tenancy by large owners of land at moderate to high population density to circumvent the diseconomy of scale (section 2). Incentives issues of collectives are also analyzed with this analytical apparatus (section 4).

Level C models provide little insight into the process by which large landownership holdings could accumulate or be perpetuated in systems characterized by voluntary transactions and competition, and with constant or diminishing returns.

Level D adds several material conditions relating specifically to agricultural production, generating the analytical apparatus used by Meillassoux (1981) or Binswanger, Rosenzweig, and McIntire (1986, 1987). The material conditions most frequently used in this paper are covariance of risk and returns among farmers and workers in a given agricultural region, the immobility of land, which - when it is scarce - makes it into a preferred store of wealth (relative to stocks and livestock, for example) and of collateral, and exogenously given population density and processing characteristics of specific agricultural commodities.

Covariance creates enormous difficulties for intertemporal markets for crop insurance and credit. Because of land's preferred role as store of wealth and as collateral, an insurance and collateral benefit is associated with landownership. Together with the failure of intertemporal markets this preferred role explains the prevalence of distress sales and the accumulation of large landownership holdings even in a competitive environment with strictly voluntary contracts and diseconomies of scale (section 5). The potential failure of land sales markets to improve efficiency in an environment with missing or imperfect intertemporal markets is a powerful and historically relevant illustration of the theorem of second best (Lipsey and Lancaster 1957) of neoclassical economics.

The explanation of variations over time and space of property rights to specific plots of land (sections 1 and 2) requires the introduction of population density and its association with the farming systems and the farm technologies, as explained by Boserup (1965). The seasonality of production, the timeliness requirements of specific crops, and the economies of scale of the processing plants or transport facilities required for them are necessary material conditions to explain the survival, in only a few specific plantation crops, of wage plantations in the absence of slavery or indentured labor (section 4). Note that anthropologists, like Marvin Harris, who use behavioral-materialist approaches also carefully specifying their detailed material assumptions, although their themes extend well beyond those discussed in this paper.

Level E partly abandons the assumption of voluntary contracts (for the case of slavery and bondage) and extends the analysis beyond individualistic approaches and transactions by introducing rent seeking, coalition building, and the coercive power of the state to enforce laws. These additions facilitate the explanation of the use of bondage and slavery, tribute systems, state

allocations of preferential land rights and enforcement powers to ruling groups, distortions in commodity and factor markets, and distortions in public expenditures specifically intended to extract rent and make large ownership or operational holdings competitive with independent family farms (section 2 and 3). The historical literature has sharply differentiated between coercive and noncoercive methods of rent extraction and has often equated the elimination of coercive means with the leveling of the playing field. While there are certainly important qualitative differences between coercive and noncoercive means, the differentiation seems to have obscured the continuity of rent seeking or surplus extraction along alternative paths such as taxation of the free peasant sector, land allocation, monopoly marketing, and the allocation of public spending.

Level E explains the emergence and persistence over time of highly dualistic farms size structures as the result primarily of a rarely broken chain of rent seeking (sections 2 and 3). It explains the poor economic performance of many such systems as the result of a dissipation of rents into the cost of competition for them among rent-seeking groups.[29] Within the chain of rent-seeking, the officially sanctioned set of legitimate instruments of rent seeking may be progressively reduced by gradually eliminating slavery and serfdom, tribute and corvée, and land rental, until only output and factor market distortions and differential allocation of public expenditure remain. With exogenous variation in the set of instruments available for rent seeking, this framework of analysis can explain a substantial proportion of the variation over space and time in the level of use of each of the available instruments. For given instruments, modeling at level D can also, in principle, investigate the income distributions and efficiency costs associated with the resulting distortions, while the theory of rent seeking behavior (Tollison 1982) can be used to investigate the extent to which rents are dissipated in the process of competing for them.

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[29] Brenner (1975, 1985) argues that under feudalism the rents extracted from peasants by landed elites were almost completely dissipated and that the resulting failure by peasants and landlords to reinvest in land improvements and draft animals was responsible for the extension of arable farming to marginal lands and the declining productivity associated with population growth in feudal European agriculture. Thus it was the rent seeking itself that led to the Neo-Malthusian or Ricardian subsistence crises of the twelfth and thirteenth centuries, rather than to population-induced positive Boserup-sequences of investment, change in technique, increased division of labor, and agricultural productivity growth. This explanation of stagnant or declining productivity is similar to that documented by Krueger, Schiff, and Valdes (1992) to explain the recent stagnation of agriculture and limited technical change in much of Africa as a consequence of the extraordinary high taxation of (mostly smallholder) agriculture in many African countries by urban-dominated states.

Finally, *level F* asks questions that are touched on only lightly in this paper about what determines endogenously the changes in the set of instruments available for rent seeking or surplus extraction in a given country at a given time. Population density and its distribution over space becomes and endogenous variable. The questions include the extensively debated issues of the demise of feudalism and bondage (Marx; Dobb 1977; Brenner 1985); the abolition of slavery (Fogel and Engerman 1977; Meillassoux 1991); the elimination of corvée, tribute, and debt peonage; the power to monopolize output and input markets (Anderson and Hayami 1986); elimination of the land rental option; and land reform (de Janvry 1981). The questions analyzed also include why revolt and revolution are necessary in some cases, while in others a change in the set of instruments available is successfully accomplished by reform, and why some reforms lead to stable and efficient production relations, while others result in institutions that are unsuccessful in either equity or efficiency.

These are the grand themes of historians, classical economists, and Marxist historical materialist analysis. These issues usually involve coalitions (or their breakdown) that, except in purely agrarian societies, extend beyond opposing rural groups to include manufacturing, trading, financial, bureaucratic, or foreign interests. Therefore additional exogenous elements (including material ones) from outside agriculture must be factored into the exploratory framework. Much of the work on these themes that we have come across neither explicitly specifies assumptions about the distribution of information (level C) nor formally includes into the analysis specific material conditions of agriculture (introduced in level D) or other sectors of the economy. And while rent seeking of level E is implicit in the questions asked, and coalitions or their breakdown are discussed, the coalition building associated with rent seeking is rarely modeled explicitly. There may be some gains to be had from more formal considerations of these omitted elements and their incorporation into the structure of the analysis of these grand themes.

Appendix 1

Interventions to Establish and Support Large Farms

The literature on emergence and evolution of manorial estates and the production relations prevailing within such estates has focussed largely on examples from Europe (mainly Britain, France, Germany, and Eastern Europe). This appendix, which explains table 1 in the text, provides evidence on the establishment and evolution of large farm systems from a wider range of settings and covers a longer time period.

The examples discussed here all suggest that neither the establishment nor the continued existence of large farms were due to their superior economic efficiency and/or the presence of economies of scale in agricultural production. The establishment of large farms was due to government intervention in favor of large landholders via land grants and differential taxation. Withdrawal of these privileges led either to their disintegration into landlord estates or to a shift towards rent seeking and more subtle forms of support for large farms.

Asia

India (North)

Land market interventions. The hacienda system is already described in the Arthshastra from the 4th century BC. In the first century, land grants comprising some ten or more villages each were made to priests and to a few members of the ruling family and high officers of the state (Sharma 1965). This process of land grants "culminated in the 11th and 12th centuries, when Northern India was parcelled into numerous political units largely held by secular and religious donees who enjoyed the gift villages as little better than manors" (Sharma 1965:273).

Differential taxation and labor levies. Corvée labor emerged in the second century and remained prevalent until the tenth century. Between the fifth and tenth centuries, where population density was high enough, as in Gujarat, Rajasthan, and Maharastra, permanent tenants were reduced to tenants at will. Where population density was low, tenants and artisans were tied to the soil in the same manner as serfs in medieval Europe (Sharma 1965).

China (South)

Differential taxation and labor levies. The equitable land allotment system introduced around 600 under conditions of land abundance allocated land equally among all members of the community in return for tax payments. Slaves received the standard size of plot but had to pay only half the taxes demanded from free men (Chao 1986). Peasants, however, could not escape the tax burden since farmers who fled to uncultivated lands were returned to their village by the authorities. DeFrancis (1956) quotes reports of 600,000 "refugees" having been collected in a single year (544). To escape the tax, many cultivators presented themselves as serfs or "bondservants" to large landholders or monasteries, leading to the emergence of large estates. In a major land reform in 1369 under the Ming dynasty, the estates were broken up into small freehold farms (Eastman 1988). Following the land reform, tax captains were installed to administer tax collection from units of 110 households each and to deliver grain taxes to government warehouses. Using corvée labor and bondservants, they were also active in land clearing to expand their revenue base (Shih 1992). They accumulated modest

estates of their own thanks to their ability to provide credit. Increasingly heavy tax demands (to finance wars) left many tax captains in a desperate situation.

The new gentry class that began to emerge in the fourteenth century was exempt from both taxes and labor services. Since gentry landlords did not pay taxes, they were able to reap higher returns from land and accumulate wealth. They were able to further increase their holdings after periods of disaster by foreclosing on lands they had accepted as collateral for credit (Shih 1992). These advantages made it easy for members of the gentry to accumulate land, decrease the tax captains' revenue base, and finally buy out bankrupt tax captains, who by the end of the century had lost most of their land to gentry landlords. As gentry landlords increased their moneylending activities, small owners in financial difficulties had to resort to selling their land or selling themselves to gentry landlords as serfs or bondservants, thereby obtaining partial exemptions from their tax obligations. Gentry estates grew to several thousands of hectares in size, with a labor force of over 10,000. The estates were often split up into smaller farms of about 500 hectares, managed by specially educated bondservants (Shih 1992).

Following the change from the Ming to the Qing dynasty in 1644, gentry landlords lost their tax privileges. Declining population and greater opportunities for off-farm employment during 1630-50 increased the amount of land available and, as in Western Europe, improved the position of peasants (Shih 1992). In the second half of the seventeenth century, the heritability of serf status was repealed, and serfs were fully emancipated in 1728. Operation of a large home farm using wage labor was no longer profitable, and landlord estates emerged (Wiens 1980), considerably improving the position of tenants. Tenancy allowed operational holdings to adjust to household size and led to very labor-intensive cultivation and high yields (Feuerwerker 1980).

Japan

Land market interventions. To provide incentives to make the investments required to transform wasteland into paddy land, the land reclamation bill of 723 made such land the heritable personal property of the developer. This provision led to the emergence of a separate category of private land that was tax exempt and excluded from the communal tenure system in which land was redistributed every six years among all members of the community (Takekoshi 1967).

Differential taxes and labor levies. In return for such land allotments, farmers had to pay tribute in kind as well as special labor services of up to 140 days a year (Takekoshi 1967). Cleared and temple lands, as well as land belonging to the nobility, were exempt from all tribute requirements. In order to obtain immunity from tributes, many landowners transferred their lands to temples or members of the nobility. While they had to give up the heritable right to the land, original landholders did in most cases continue to manage the land and home farm cultivation remained minimal. Higher officials could accumulate manors of enormous size, but in turn had to commend their properties to higher-ranking individuals to protect the immunity of their manor from tribute requirements, leading to a complex tenure-hierarchy in which shares of manors and associated rights to income were traded (Sato 1977). Around the end of the fourteenth century increasing land scarcity, as evidenced by physical fragmentation of fields due to intergenerational transfers, led to a gradual conversion to landlord estates (Keirstead 1985), which remained in place until the nineteenth and twentieth centuries.

Java and Sumatra

Land market interventions. The Agrarian Land Law of 1870 declared all uncultivated land inalienable state property and leased it to European companies which established large scale plantations.

Differential taxes and labor levies. These plantations were operated almost exclusively using indentured labor (Breman 1989). Laws such as the "coolie ordinance" from 1880 imposed severe penalties on indentured workers who absconded and prison terms on anybody employing such runaway workers, thus indicating the scarcity of labor (Stoler 1985). Large scale cultivation was limited to these plantations. Where individual peasant holdings prevailed at the beginning of colonial rule, authorities used the "cultivation system" (1820) to appropriate surplus without expending resources for capital investment, and relying on traditional land tenure and labor exchange arrangements. This system required farmers to grow cash crops (predominantly coffee or sugar) for the government on one-fifth of village lands in lieu of a land tax (Hart 1985). Both of these crops were integrated into the local systems of rice or upland cultivation (Geertz 1963).

Philippines

Land market interventions. Land grants were given to private individuals and religious orders after 1571 (Roth 1977) and by 1700 all of the best land was under the control of large estates (Cushner, 1976).

Differential taxation and labor levies. The Philippines, like countries in Latin America, had both *encomienda*—the right to tribute in labor, cash, or kind from a particular region—and *repartimiento*—which distributed workers for public works and private Spanish businesses. The systems differed from those in Latin America, however, in that the right to labor services was hereditary and often included whole villages. Workers on European haciendas were exempted from heavy public works and from taxes, making hacienda employment highly attractive. Despite this advantage, the lack of economies of scale led to almost immediate disintegration of rice-cultivating haciendas into landlord estates. Moreover, by the nineteenth century, sugar production as well as processing were controlled by tenants as well (Roth 1977).

Sri Lanka

Land market interventions. Upland areas where slash and burn cultivation was practiced were declared crown land in 1840 (Bandarage 1983) and sold to private cultivators, mainly British, who established coffee plantations.

Differential taxation and labor levies. Corvée labor was abolished on public lands in 1818 and replaced by a grain tax amounting to 10 percent of gross produce. Export agriculture —all land under coffee, cotton, sugar, indigo, opium poppies, and silk— was exempted from the tribute (Bandarage 1983).

While landed interests had successfully opposed the imposition of a general land tax, the opportunity to earn income from coffee cultivation, together with the absence of a totally landless labor caste, severely limited the willingness of local people to supply labor to estates. Thus almost the entire agricultural work force on coffee estates had to be imported: Census figures indicate that in 1871 and 1881, 97 percent of some 200,000 plantation workers were indentured Tamils, mainly from India. The 3 percent of Singhalese plantation workers were mostly low-country artisans who were

paid competitive wages and used their position to accumulate capital for own land purchases (Bandarage 1983).

Europe

Prussia

Land market interventions. Land grants in Prussia date from the thirteenth century and were made to knights and nobles who were to colonize the largely unpopulated territory and provide military services to the king. Initially, population density was so low that very favorable terms were required to attract peasants: peasants received hereditary usufruct leases to about 32 hectares of land each. Noble knights operated modestly sized demesnes of about two to three times the size which was provided to settlers (Hagen 1985) to supplement the rents they received from peasants. They were "not the master but the neighbor" of the farmer, and in economic terms they often fared worse than full peasants (Lütge 1979). Depopulation caused by the Black Death increased the amount of land available to the nobility who became "land rich but labor poor". Productive use of this land could be maintained only by attracting and settling new farmers, often on terms which were quite favorable to the settlers.

Differential taxation and labor levies. While settler farmers had a legal right to leave without the lords' consent as late as 1484 (Hagen 1985), the *Landesverordnung* of 1526 no longer mentioned the right of the farmer to take legal action against a landlord who would not allow him to leave (Abel 1978), indicating landlords' increased bargaining power (due to higher population density). Such restrictions on peasants' mobility facilitated more widespread adoption of labor rents and an increase in labor requirements from two days of service a week for full peasants in 1560 to three days around 1600 (Hagen 1985). Still, landlords had to rely on hired workers in addition to compulsory labor services, estates were relatively small: In 1624, Junkers' demesne took up only 18 percent of the cultivated land (Hagen 1985). The main benefit of labor services for landlords was the obligation of full peasants to supply a pair of oxen or horses and a driver rather than the contributions made by non-full peasants (*nicht spannfähige Bauern*) to demesne cultivation.

Although landowners increased the size of their demesne by adding the land of families who died during the plague years of the fourteenth century and the Thirty Years War of 1618-48, large farms began to dominate in Prussia only after the land reform in 1807-50 (Lütge 1979). Three aspects of the reform contributed to the emergence of large farms: the terms of separation requiring farmers with hereditary or nonhereditary lifetime leases to cede one-third or one half their land to the Junkers in return for freedom; the initial limitation of reform benefits to "full peasants" and its extension to other peasants without long-term lease rights only in 1850 when, most people agree, it was "already too late" (Dickler 1975); and repeal of tenancy protection laws, which had been in place since 1750. These factors allowed Junkers to vastly increase their demesnes and to draw on an increased pool of wage labor. The typical Junker style of cultivation with permanent laborers residing on house plots emerged as the predominant form of production organization (Lütge 1979). After farm workers became free to migrate in 1868 and began moving westward (Wunderlich 1961), they were gradually replaced by salaried and migratory seasonal workers, especially from Poland, where population density was high and landlessness was widespread (Dickler 1975).

Input and output market interventions. From the earliest settlement days, knights had certain rights of jurisdiction and monopolies on milling and on the manufacture and sale of alcohol.

However, the fact that they were willing to cede a good deal of their trade-related privileges to entrepreneurs who engaged in land-clearing and attracting settlers from the west illustrates just how pressing the labor scarcity was.

Russia

Land market interventions. In the fourteenth century, princes, considering all land in their princedom as their patrimony (votchina), granted land to nobles who could provide the labor force necessary to cultivate the land and pay taxes. These landlords in turn had to attract peasants with very favorable terms. In-kind payments (obrok) remained the predominant type of peasant obligation, and, due to the limited ability to impose labor rents (barshchina), home farm cultivation was almost nonexistent (Blum 1961).

In 1565, Ivan IV confiscated the property (votchina) of almost all the old princedoms, converting it into state land (oprichnina) and then using it for land grants to reward servitors. Servitors did not receive freehold title, acquiring only usufruct rights under service tenure (pomestye) which became the dominant form of lay seignorial tenure. As a result, "the personal possession of landed property became a monopoly of a single class of Russian society—the servitors of the tsar" (Blum 1961:169). As land rights could be terminated at will by the tsar, continued possession of the land was conditional on the performance of service to the state. Indeed, landlords who could not provide payment in service or money were evicted, and the class of servitors was subject to high fluctuations, competition for labor was fierce, and home farm cultivation remained very limited. The economic situation of the servitor was often precarious until tenures gradually became heritable in the seventeenth century (Blum 1961).

Restrictions on labor mobility and differential taxation. The extent of labor scarcity is illustrated by continuously more severe restrictions on peasant cultivators' mobility. Between 1400 and 1450, the right of peasants to terminate leases and move on to another landlord was restricted to two weeks each year. Even then peasants were required to pay formidable "exit fees" (equivalent to 300 bushels of oats or 120 bushels of wheat; Blum 1961) before leaving. Landlords competed fiercely for labor and resorted to "labor pirating", i.e. attracting workers from other estates by promises. In fact, such labor pirating became "the principal lawful way by which renters transferred from one lord to the other", though illegal means were often resorted to as well (Blum 1961). The introduction in 1588 of "forbidden years" during which the peasants' right to move was temporarily suspended did not prevent labor pirating because the law could not be enforced. Decrees in 1597 and again in 1607 bound all peasants to the place they were residing at the time of the census of 1592, which facilitated enforcement of the law. The Assembly Code of 1649, which remained valid until about 1850, abolished statutes of limitation on the return of fugitive peasants to their original landlord. It also made serfdom heritable by prohibiting the peasant's wife and progeny from moving as well. After 1661, fines for peasant raiding had to be paid "in serfs": for every illegal peasant found on a landlord's holding, the landlord had to give up one of his own serf families. Serfs could be freely sold; restrictions prohibiting the sale of serfs without land were unsuccessful. Serfs were also used as collateral, to be auctioned off if their landlord went bankrupt. In 1859, two-thirds of all serfs were mortgaged. After 1719, the privileges of peasants—mainly at the frontiers—who had escaped serfdom were successively eliminated. They became serf-like state peasants, subject to taxes, quitrent, and conscription. By 1850 more than 90 percent of the male population were serfs (Blum 1961).

In 1580, landlords' home farms (demesnes) were exempted from taxation. With revenue requirements also rising, the tax burden on peasants increased substantially, significantly lowering the potential return from cultivation (Blum 1961). Peasants responded by running off to the frontiers where landlords were keen to attract labor and, because of temporary exemptions from taxes, were able to offer better conditions.

Landlords attempted to tie peasants to their holdings through debt peonage. Under laws passed between 1586 and 1597, a debtor automatically fell into debt servitude if he was unable to repay the loan on time. He then had to work continuously for the creditor just to pay the recurrent interest. Without any possibility of repaying the principal, debt servitors' only advantage over slaves was that they were to be freed following the creditor's death (Blum 1961).

Input and output market interventions. Since neither serfs nor state peasants were allowed to engage in independent business until the 1820s or 1830s, landlords enjoyed a de facto monopoly over commerce in their area, in addition to their formal monopoly on alcohol manufacture and sale.

Latin America

Chile

Land market interventions. In the mid-sixteenth century, town councils, free of the central supervision by a viceroy or governor that was common in Mexico and Peru, handed out land to settlers "with utmost generosity and ... in the face of royal legislation to the contrary" (Bauer 1980:4). In contrast to other Latin American countries, where the right to tribute was legally distinguished from land grants, and the de jure protection of Indian communal land was enforced by central authorities, *encomenderos* in Chile received land grants in the middle of "their" Indians' communal lands early on. The *encomenderos* were thus provided with cheap and abundant labor services such that "by the 1650s landownership and *encomienda* were fully integrated ...[and] the *encomienda* was absorbed by the land" (Bauer 1980:8).

Differential taxation and labor levies. The main means to provide labor to the mines was the *mita* which required all Indian settlements to supply a certain proportion of their labor force for agriculture or public works, but in most cases the mines. Hacienda workers were exempt from the *mita* and many Indians sought refuge from the cruel forced labor requirements by joining the ranks of the *yanaconas*, a group which had given up all ties, including land rights, to their original communities and, living in total dependence on individual Spaniards, formed the nuclear labor force of the Spanish estates.

A rise in demand for wheat from Lima in 1687 led to a considerable increase in such labor requirements with landowners relying on either reconstituted *encomienda* or on *yanaconas* who were virtually enslaved and only given 3 days off a year to tend their house-plots (Pearse 1975). As on the Eastern European Junker estates, able tenants were used as "labor brokers" and obliged to supply the hacienda with workers (*peones obligados* or *reemplazantes*) nearly year-round (Kay 1977).

Input and output market interventions. Large wheat growing farms in the Central region could not compete against wheat produced on the more dynamic (and smaller sized) farms in the South and were converted into livestock ranches. In order to protect them from competition from Argentina they

lobbied successfully for the imposition of import taxes on beef at the end of the 19th century. Such taxes were maintained despite consumer riots caused by high food prices in 1905 (Kay 1992). In this century, large landowners received special treatment to reduce the cost of mechanization. They received exemptions from import tariffs and low interest rate loans; real interest rates on mechanization loans in most of Latin America during the 1950s and early 1960s were actually negative. Farmers in Chile, Argentina, Brazil, and Venezuela paid back only 50 to 80 percent of their equipment loans (Abercombie 1972).

El Salvador

Land market interventions. Public land was granted to anybody who was planting it at least two third with coffee from 1857 (Lindo-Fuentes 1990). A large land titling program, initiated in 1882, which was intended to speed up the growth of coffee production, is thought to have directly affected up to 40% of the territory of the country (Lindo-Fuentes 1990) and led to extraordinary concentration of land ownership. The 1882 law required all occupants of ejido lands to register their claims (i.e. prove that they were cultivating the land and pay the titling fee) within a period of six month. All lands not claimed in this way was to be sold at public auctions. Illiterate Indians, were often not aware of these requirements and well-connected individuals could take considerable advantage of the legislation. The goal of establishing a successful export agriculture could have been achieved by modernizing the credit system and providing education to Indians as well, in particular as Indians had proven to be responsive to market incentives before. Choice of the land market as the instrument to achieve the transformation illustrates the administrative difficulties as well as the power of the elites who would benefit from such legislation (Lindo-Fuentes 1990).

Differential taxation and labor levies. In 1825 vagrancy laws were passed requiring Indians to carry work cards certifying their employment (Lindo-Fuentes 1990). The penalty for vagrancy was imprisonment. In 1847, landowners planting more than 15 000 coffee trees obtained exemption from public and military services for themselves and all their workers.

Guatemala

Land market interventions. While the Spanish made some land grants in Guatemala in the early sixteenth century, their main land market intervention was resettlement of the Indian population in centralized villages to facilitate tax administration and conversion of Indians to Christianity. They limited their activities to ranching for which no land title was required (MacLeod 1973). Titles, which were issued to Spaniards through land grants, became important only in 1590-1630, following a shift to cultivation of indigo.

Differential taxation and labor levies. Initially, Spaniards had little interest in establishing intensive agriculture and collected tribute instead (such Indian tribute contributed more than 80 percent of royal government revenue; Brockett 1990). From 1540, tribute assessments were made in cash, and the need for cash income was an important force inducing Indians from the highlands to migrate to plantation areas (MacLeod 1973). By the 1560s and 1570s, Indians who had migrated from the highlands in this way constituted the majority of the coastal Indian population.

Beginning around 1600, Indian headmen were required to provide labor contingents (*mandamiento*)—which could be as high as a quarter of the work force—for tasks of public interest (MacLeod 295). *Mandamiento* labor was ideally suited to the seasonal demands of indigo processing.

Employment of Indians in indigo factories was widespread, despite its legal prohibition to prevent further decline of the decimated Indian population (Lindo-Fuentes 1990). The *mandamiento* system survived well into the 1880s, when it was used to provide cheap labor for European coffee plantations (Cambranes 1985).

Debt peonage was legalized in 1877, and by forcing debtors to work off their debts, provided landowners with official means of enforcing the continuation of a flow of cheap labor. Following the abolition of debt peonage, vagrancy laws were adopted in 1933 in response to the severe labor shortage. All Indians who could not prove owner-operatorship of a minimum of 1.1 to 2.8 hectares of land were forced to work—mainly on plantations—for 100 to 150 days a year to discharge their "debt to society." The requirement to carry work cards facilitated enforcement (Pearse 1975).

Mexico

Land market interventions. Resettlement of Indians beginning in 1540 deprived them of their traditional lands and placed them on smaller, less productive holdings. While the intention of the resettlement program was primarily to raise money for the crown by selling the Indians' land to Europeans, the expropriations seriously reduced the productive basis of the Indian agricultural economy (Gibson 1965; Taylor 1988).

Communal lands were expropriated in the 1850s, and as land became increasingly scarce, fewer alternative opportunities were open to potential tenants. "The expropriation of communal villages brought about two contradictory tendencies. On the one hand, cheap temporary labor became more readily available than before. This made it economically less and less necessary for the hacienda in central Mexico to rely on forced labor. On the other hand, as the haciendas acquired more and more land, much of it of mediocre quality, they preferred not to work it themselves but to shift the risk to sharecroppers and tenants. The condition of these occupants was so precarious that many of them ... inevitably incurred debts with the hacienda which they could not repay" (Katz 1974:41).

Differential taxation and labor levies. Spanish settlers received, after 1490, *encomiendas*, i.e. rights to Indian villages from which they could extract tribute in kind and labor services. Restrictions limiting the use of tribute labor in agriculture were imposed in some regions, in order to secure labor supply for public works.

In 1542, the original *encomiendas* were restricted to the right to collect tribute and the system of *repartimiento* was used to distribute Indian labor, supposedly in a more equitable way. While this restricted the power of the original beneficiaries of the *encomienda*, it worsened the lot of Indians who still had to pay tribute to *encomenderos* and to render labor services under *repartimientio*.

Tribute requirements remained in place but could be avoided by working on haciendas (the hacienda paid the tribute). Tribute was often required to be paid in cash, forcing many highland Indians to migrate to lowland areas to obtain the necessary cash income (Moerner 1978).

Debt peonage was not significant in the early period of colonization, but it later acquired importance as a means of tying laborers to the hacienda and lowering their wages. In 1790, 80 percent of peons in one area had a total debt higher than the legal limit; their average debt was equivalent to eleven months' wages (Taylor 1972). As landlords let debt accumulate up to the point of the expected future value of work performed, the system came very close to slavery (debt peons were

even being traded by redeeming the debt to their current employer). A law enacted in 1843 secured not only state enforcement to "collect" debts incurred to haciendas but also made it illegal to hire laborers who had left their hacienda without paying their debts and required that they be returned (Katz 1974). Vagrancy laws passed in 1877 and strictly enforced led to a considerable increase in the employment of deportees and "criminals" (Katz 1974).

Viceroyality of Peru (present day Peru, Bolivia, and Ecuador)

Land market interventions. Beginning in 1540, land grants became common in this region, with grants of 120-800 hectares being relatively easy to obtain. The main beneficiaries were the *encomenderos*, i.e. Spaniards who had received rights to labor services from whole villages (see below), since without Indian tribute labor to work the land, the latter was virtually worthless. Once all the land set aside for this purpose had been exhausted, around 1557, "private" Indian land was expropriated and distributed among Spaniards (Gonzales 1985; Davies 1984).

In the coastal areas, resettlement under Viceroy Toledo in 1570 moved Indians into newly established towns where they were assigned farmlands of often inferior quality. Programs to review existing Spanish land titles under which "Spaniards could legally acquire land that they had previously stolen from Indians by paying a fee to the Crown" (Gonzales 1985:15) were introduced in 1589. In 1641 the same pattern was applied even more rigorously to improve the financial position of the Spanish crown: there were large-scale expropriations of Indian land, and all surplus land was sold to Europeans. Indians "suffered a considerable reduction in their holdings; they now possessed some of the worst farmland in the valley" (Davies 1984:130). In the Arequipa Valley, adult married men were allotted an area of only about half a hectare.

Differential taxation and labor levies. Beginning around 1530, the *encomienda* conferred rights to tribute (in labor, cash, or kind) from a particular region to Europeans, who replaced local overlords. Holders of this privilege (*encomenderos*) were, at least at the beginning, completely unregulated as to how much or what form of tribute to assess(Ramirez 1986). While many used labor tributes to cultivate large farms, assessment of tributes in cash did reportedly force Indians to borrow funds and sell off abandoned lands to repay their debt (Davies 1984). The right of individual *encomenderos* to the exclusive use of Indian tribute labor for personal services was abolished about 1550, mainly to free labor for public works and the mines. The other benefits of *encomienda* remained, however.

With the abolition of encomienda, the Spaniards transformed the *mita*, an Incan institution for recruiting labor for public works projects, into a permanent labor-recruitment arrangement for the mines. In addition to paying tribute to the *encomendero*, each village had to supply a percentage of its work force for "public works," which mostly meant work in the mines. As work for Spanish haciendas exempted from the *mita* and tribute requirements, many workers in the *altiplano* are reported to have accepted work on haciendas. The class of *yanaconas*, who were resident on haciendas and had completely abandoned their tribal identities, emerged (Pearse 1975).

Slavery was extensive after 1580 in the coastal valleys for the production of sugar, cotton, and wine (Davies 1984). When slavery was abolished, sugar plantations resorted to indentured labor from China and Japan, which comprised more than 90 percent of the work force on some estates (Gonzales

1985). Other crops, predominantly cotton were, however produced under tenancy contracts (Gonzales 1991) after slavery was no longer available, suggesting that this form of labor was more profitable than farming the area under large farms.

Africa

Algeria

Land market interventions. With the French occupation, all state, religious, and tribal land became state property; uncultivated and waste land was subject to titling which allowed settlers to acquire land at no price and "amounted to little short than robbery" (Ageron 1991). In some cases, such titling left the Muslims with slightly more than 5% of the land area and much of the land declared waste included land grazed by nomads in the course of their migrations. Since the number of settlers remained limited, various forms of settlement (including establishment of native villages) were tried to make the colony economically viable.

The desire to impose French rule in Algeria after the 1870/71 rebellion led to initiation of a large colonization and settlement program between 1871 and 1882. At a huge cost to government, settlers were provided free land and infrastructure but either sold out or farmed their land with native sharecroppers (Ageron 1991). The so-called 'settlers' law' from 1873 allowed Europeans to acquire rights to vast amounts of community land by purchasing a small share thereof and led to the accumulation of vast estates at little cost (Ageron 1991).

Differential taxes and labor levies. Beginning in 1849, all Arabs had to pay head taxes from which those working as sharecroppers or wage laborers on European farms were exempt (Bennoune 1988). Still, while "they had always been willing to cultivate for the French as khammes or sharecroppers", at the beginning of the 20th century only about 12% of Arabs were working as farm laborers. French viticulturalists relied on foreign, immigrant labor from mediterranean countries. Differential provision of credit to Europeans, led to rapid growth of vine cultivation. Market fluctuations, together with additional land grants to the newly-rich settlers, led to the consolidation of large estates of between 4000 and 5000 ha.

Angola

Land market interventions. In 1838 and again in 1865 all "unoccupied" land could be given as concessions to Europeans. "The settlers were given lands, seeds, tools, and slaves by the government, and measures were taken to ensure that their products could be sold" (Clarence-Smith 1979, 15). From 1907 to 1932, 98 square miles were set aside for native reserves, 4 square miles were given to Africans along with land titles, and about 1,800 square miles of the best land was given to Portuguese settlers and other foreigners (Bender 1978).

Differential taxation and labor levies. After the abolition of domestic slavery in 1875, slavery continued in a variety of forms but due to tremendous demand for labor from the cocoa plantations of Sao Tome, prices for slaves increased steadily, making it more profitable to export workers than to use them on inefficient settler farms (Clarence-Smith 1979). Vagrancy laws passed in 1875 subjected all "nonproductive" Africans to nonremunerated labor contracts (Bender 1978). The laws were replaced in 1926 by native laws, which provided for payments of wages but retained the provision

that all Africans had to work for European landlords or could be contracted by the state (Henderson 1980).

Egypt

Land market interventions. Land grants of the 1840s gave some 40 percent of the land to Turko-Egyptian landlords and facilitated the formation of large estates (Richards 1982). Expropriation of communal lands which took place in 1850-70, exacerbated this trend. Land taxes in 1856 (per acre) were four to six times higher for smallholders than for the large land holdings (Richards 1982) and in many cases large landowners did not pay taxes at all (Owen 1986).

Differential taxation and labor levies. In contrast to their usual practice, the Ottomans in the sixteenth century did not distribute Egyptian lands to military leaders but assessed collective tribute. They wished to avoid disrupting agricultural production in Egypt, "the granary of the Ottoman Empire" (Richards 1983:7). Corvée laborers were recruited initially for public works to set up an extensive irrigation system and later for cotton production on the ruler's home farm. Following the large land grants made in the 1840s, "large landowners arranged to have corvée laborers work on their estates and to get their peasants exempted from the corvée" (Richards 1982:23), thus closely paralleling events on the Latin American *hacienda.*

Large landowners obtained considerable direct government subsidies for cotton-price stabilization programs in the early 1920s and 1930s, supplemented by an official limitation of the amount to be planted to cotton and financial support to lower interest rates for large landowners which, by the 1930s, were heavily indebted. Similarly, imposition of tariffs on imported flour in 1932 and 1934 and protection of the market for domestically produced sugar, directly supported large landowners (Owen 1986).

Kenya[30]

Land market interventions. With the arrival of Europeans, all vacant land was declared to be Crown land and sold to European settlers at extremely favorable conditions. Much of the land continued to be farmed by African tenants, which were called squatters (Mosley 1983). Africans' land rights were limited to reserves and a formal prohibition of African land purchases outside the reserves was codified in 1926.

Differential taxation and labor levies. The British introduced a number of regressive hut and poll taxes in order to "increase the native's cost of living" (Berman 1990:509). To pay these taxes, Africans initially did not seek wage labor but increased production, mainly on tenanted land. Despite repeated requests from settlers to grant tax-exempt status to Africans working on European farms, such taxes had to be paid by workers as well, thus large estates based on wage labor remained relatively unprofitable as compared to tenancy.

The squatter law from 1918 required tenants to provide at least 180 days a year in labor services to their landlord at a wage not to exceed two-thirds of the wage for unskilled labor. This ordinance was amended twice (in 1926 and 1939), both times increasing the minimum amount of

[30] For more detail on Kenya, South Africa, and Zimbabwe, see Deininger and Binswanger (1992).

labor services (to 270 days per year in 1939), limiting the area allowed to be cultivated as well as the amount of stock owned per tenant, and making eviction of tenants easier. Labor passes, which had been introduced in 1908, limited the mobility of Africans; leaving without the employer's consent was a criminal offense (Berman 1990).

Input and output market interventions. A dual price system for maize, adopted in the 1930s, reduced the returns African farmers could obtain for the same produce as supplied by their European counterparts and, in addition, unloaded most of the price risk on Africans (Mosley 1983).

Grower associations that excluded Africans were formed for most of the important cash crops. High licensing fees kept Africans out of pyrethrum production, and they were prohibited outright from cultivating coffee (Berman 1990).

During World War II, European farmers received direct subsidies to mechanize their farms (Cone and Lipscomb 1972).

Sokotho-Caliphate (present day Burkina Faso, Cameroon, Niger, and northern Nigeria)

Land market interventions. After 1804, land was granted to settlers by the caliphate government in the areas around defensive centers, the amount of land depending on the number of slaves owned. Thus "anyone with slaves could obtain enough land to start a plantation" (Lovejoy 1980). There were about 100-200 slaves per plantation, although there are reports of officials who managed to obtain holdings of more than 1,000 slaves (Lovejoy 1978).

Differential taxation and labor levies. The pattern of "slavery" in the area, which was populated by Hausa and Fulani, was characteristic of many parts of Africa in the nineteenth century (Lovejoy 1980).[31] Slaves which made up some 50 to 75 percent of the local population were acquired by warfare, direct seizure, or as tribute from subjected tribes. Limited export markets and the relatively low price of slaves (landowners could replenish their bonded work force through independent raids; Lovejoy 1980) allowed relatively lenient treatment of slaves who enjoyed more rights e.g. the possession of heritable house-plots (Hogendorn 1977) and the right to self-redemption often using funds acquired by cultivating surplus land (Hill 1978) than the slaves acquired for cash by market-oriented plantations in the Americas. Land and the absence of economies of scale meant, however, that slave owners had to take measures to prevent slaves from escaping and establishing their own operations (Hogendorn 1977). Eventually, these factors led to the demise of the large holdings (Hopkins 1973).

Malawi

Land market interventions. In 1894, Europeans were allotted more than 1.5 million hectares, or about 15 percent of total arable land.

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[31] There is some discussion in the literature on the appropriate nomenclature for this system, which combines elements of slavery and serfdom.

Differential taxation and labor levies. Attempts to introduce labor tenancy on European-owned cotton lands were unsuccessful as farmers abandoned the land and fled to uncultivated crown land. The situation improved only as a law was introduced in 1908 which allowed Africans to gain a significant reduction in the head tax they had to pay by working for European cotton growers for at least one month a year. Africans' possibility to gain a similar reduction of the head tax by producing cotton on tenanted land, was, due to landowners' pressure, eliminated (Mandala 1990).

Mozambique

Land market interventions. Exclusive property rights in land and quasi-governmental authority, were in the early 19th century, granted to lessees (often companies) for a period of three generations under the institution of *prazo*. The prazo-holder had to provide minimal public services, cultivate part of the property, pay quitrent and tithe, but could levy annual tributes (in cash, kind, or labor) on the local population and (see below) was endowed with a complete monopoly on all trade within and outside the area (Vail and White 1980).

Differential taxation and labor levies. Hut taxes were established in 1854. After 1880, at least half of the tax had to be paid to the local *prazo*-holder in the form of labor services (Vail and White 1980).

Under the vagrancy law of 1899, all male Africans between fourteen and sixty years old were legally obliged to work. The area of crops to be grown or the wage-employment required to satisfy this obligation could be varied by local *prazo*-holders, providing them with ample instruments to increase the supply of labor. Contingents of migratory labor were often "sold" to other areas (such as South Africa) where labor was relatively scarce (Vail and White 1980). Vagrancy laws were repealed in 1926 — at about the time many *prazos* were expiring— and the use of forced labor for "private purposes" (i.e. non-quota production) was banned. The labor code of 1942 instituted an obligatory labor requirement of six months for all African men.

Input and output market interventions. In 1892 all itinerant African trade within *prazos* was abolished, conferring a monopoly on *prazo*-holders of all commerce in their prazo (Vail and White 1980:132). *Prazos* turned into a kind of mini-state, each with its own closed economy and unlimited freedom for the prazo-holder to determine the terms of trade. Deprived traders to provide outlets for their produce "that had made peasant production so attractive to the local people" Africans almost completely withdrew from cash-crop productions and the *prazos* became "private labor pools from which the companies, by direct force or by indirect manipulation of the economy, could compel the labor they required" (Vail and White 1980:132). Following their expiration about 1930, *prazos* were replaced by a "concession system". Concession holders received monopoly rights to purchase cotton and rice at state-administered low prices from African growers in return for enforcing Africans' work obligations and providing inputs and supervision (Isaacman 1992). Although exactions from Africans were still high, (forced) cultivation of all but sugar reverted to smaller scale units rather than large scale farms.

South Africa

Land market interventions. Native reserves were firmly established at the end of the 19th century although they were legally defined only in 1912. For example in Transvaal in 1870, the area allocated to African reserves was less than a hundredth of the area available to whites (Bundy 1985).

The Glen Grey Act (1894) restricted African land ownership in the reserves to a parcel of no more than about 3 hectares and instituted a perverted form of "communal tenure" which banned the sale, rental, and subdivision of land in order to prevent the emergence of a class of independent African smallholders (Hendricks 1990). The inability to sell land in the reserves, which persists up to this day, is recognized to be major reason for the low productivity of agriculture in the homelands (Lyne and Nieuwodt 1991).

Various legal measures to discourage tenancy on European farms such as a limit on the amount of tenants per farm in 1895 and assessment of license fees for tenants in 1896 did not lead to the desired results. The Native Lands Act (1912), circumscribed the extent of African reserves and declared real tenancy on European farms illegal, forcing all African tenants to either become wage laborers or labor tenants on European farms or to move to the reserves.

Differential taxes and labor levies. Prior to state intervention on their behalf, very limited market production by European farmers was based on slaves or, after the prohibition of slavery in 1834, indentured labor.

Masters and Servants Laws and the Mines and Workers Act (1911) restricted Africans' occupational mobility and excluded them from skilled occupations in all sectors except agriculture (Lipton 1985). Restrictions on mobility were reinforced and tightened by pass laws (influx controls) from 1922 and the establishment of labor bureaus to enforce the legislation from 1951 (Lipton 1985).

In addition to restricting Africans' ability the obtain jobs outside agriculture, more rigid pass laws and rigorous enforcement of such laws also provided a flow of cheap labor for white agriculturalists. It is estimated that, in 1949, about 40 000 pass-law offenders were supplied to farms as prison laborers (Wilson 1971).

Input and output market interventions. European farmers were assisted by a large array of monopolistic commodity marketing boards and direct credit subsidies. In 1967, the amount spent on subsidizing about 100,000 white farms was almost double the amount spent on education for more than 10 million Africans (Wilson 1971).

Tanganyika (part of present day Tanzania)

Land market interventions. From the late 1890s until 1904 it was common practice to allocate several villages apiece to incoming German settlers.

Differential taxation and labor levies. A hut tax, to be paid in cash or labor services, was imposed in 1896 "not so much for the revenue which resulted but as a means of propelling them into the labor market" (Rodney 1979, 131) although half of the hut-tax income went directly to settlers' District Councils. Village headmen were required to provide a fixed number of workers each day to provide labor for the settlers to cultivate their rubber and sisal plantations. Every African was issued a work card that obligated him to render services to an employer for 120 days a year at a fixed wage or else to work on public projects (Illife 1979). In 1902, the Germans introduced compulsory cotton production in certain coastal areas; it is widely accepted that this scheme was one of the main causes leading to the outbreak of the Maji Maji revolt in 1905 (Coulson 1982).

Africans were excluded from credit by the Credit to Natives Ordinance of 1931 which required that an African have specific government permission before he could even request a bank to lend him money (Coulson 1982). Attempts by Africans to set up a marketing cooperative for coffee led to the attempt to outlaw traditional practices of coffee growing in 1937, which led to riots. Settler-dominated marketing monopolies for African-grown crops were set up in the 1940s and creamed off most of the profits from those crops (Coulson 1982).

Zimbabwe

Land market interventions. Reserves for Africans in remote areas of often low fertility were established in 1896 although their boundaries underwent some changes until 1931 (Palmer 1977), when African land purchases outside the reserves and specifically designed "African Purchase Areas" were declared illegal.

Differential taxation and labor levies While all Africans were subject to poll and hut taxes, specific taxes discriminated against cash rental and share tenancy contracts from 1909 (Palmer 1979). The prospect of (temporarily) easing the tax load led to large-scale migration of Africans into the reserves when commodity prices were extremely low in the early 1920s (Arrighi 1970).

Input and output market interventions. Volatility and downturns in output markets were smoothed by government interventions such as increased land bank loans, debt moratoria (especially during the depression in 1930) and, after protracted lobbying by European producers, the establishment of monopoly marketing boards (for tobacco, dairy, pigs, and cotton)in selected crops and the establishment of export subsidies.

African maize and livestock producers were discriminated against by dual price systems. Pressure by European miners who were interested in cheap supplies of maize limited the extent of price discrimination against African producers in maize. Quarantine-based restrictions on African livestock sales initially led to the buildup of large herds and the associated soil degradation in the reserves. To ease this problem, in 1939, compulsory destocking was mandated; prices paid for African cattle were between one third and one sixth of the prices fetched for comparable European stock (Mosley 1983).

Appendix 2

How Market Imperfections Affect the Farm Size - Productivity Relation

Consider a region where each farm household consists of F family members capable of conducting farm operations as well as supervising the work of hired laborers.[1] The household owns V acres of land, but the size of farm it actually operates, denoted by A, is determined through renting in or renting out land at the going rental rate R. Output depends on effective labor (L) and land (A). Effective labor is defined as the product of the number of individuals employed and the effort (e) they exert. While family members can be expected to perform farm tasks with maximum effort, say $\bar{e}$, hired laborers' work effort depends on the intensity of supervision. The intensity of supervision is represented by the ratio of household members to operational farm size (F/A). It is assumed that the marginal returns to supervision intensity are diminishing,

$$e = e(F/A), \quad e' > 0, \quad e'' < 0, \quad \lim_{F/A \to \infty} e = \bar{e} \tag{1}$$

With N hired laborers per operated acre and a total of F household members, the effective labor input is given by

$$L = F \cdot \bar{e} + A \cdot N \cdot e(F/A). \tag{2}$$

Output is determined by a neoclassical production function that depends on effective labor and land,

$$Q = Q(L, A). \tag{3}$$

Assuming constant returns to scale, and substituting equation 2 in equation 3, output per operated acre is given by

$$q = Q[\bar{e} \cdot (F/A) + N \cdot e(F/A); 1] = q[\bar{e} \cdot (F/A) + N \cdot e(F/A)], \tag{4}$$

1/ This appendix is based on Feder (1985).

where $q=Q/A$ and $q'>0$, $q''<0$.

A simple but realistic way to introduce a credit market imperfection to the present model is to assume that the supply of credit depends on the amount of land owned by the household denoted V:

$$S=S(V), S'>0. \tag{5}$$

With the wage rate denoted by w, intermediate input costs per acre by c, and cash consumption expenditures per family member during the season by θ, the cash requirements of a family with an operational holding of size A are $w \cdot N \cdot A + c \cdot A + R \cdot (A - V) + \theta \cdot F$, and the working capital constraint faced by the farm is:

$$w \cdot N \cdot A + c \cdot A + R \cdot (A - V) + \Theta \cdot F \leq S(V). \tag{6}$$

The farmer's objective is to maximize end-of-season profits (accounting for interest charges i per dollar borrowed), subject to the working capital constraint. Formally,

$$\max_{A,N} \Pi = A \cdot q[e \cdot (F/A) + N \cdot e(F/A)] - [w \cdot N \cdot A + c \cdot A + R \cdot (A-V)] \cdot (1+i),$$

subject to inequality (6) and $A \geq 0$, $N \geq 0$.

Defining the Lagrangean function $\Psi = \Pi + \lambda \cdot [S(V) - w \cdot N \cdot A - c \cdot A - R \cdot (A-V) - \Theta \cdot F]$, where λ is the shadow price of the credit constraint, the Kuhn-Tucker conditions for optimization imply:

$$\frac{\partial \Psi}{\partial A} = q - q'[e \cdot (F/A) + N \cdot (F/A) \cdot e'] - (w \cdot N + c + R)(1 + i + \lambda) \leq 0, \tag{7a}$$

$$\frac{\partial \Psi}{\partial A} \cdot A = 0, \tag{7b}$$

$$\frac{1}{A}\cdot\frac{\partial\psi}{\partial N}=e\cdot q'-w\cdot(1+i+\lambda)\leq 0, \tag{8a}$$

$$\frac{\partial\psi}{\partial N}\cdot N=0, \tag{8b}$$

$$\frac{\partial\psi}{\partial\lambda}=S(v)-w\cdot N\cdot A-c\cdot A-R\cdot(A-V)-\Theta\cdot F\geq 0, \tag{9a}$$

$$\frac{\partial\psi}{\partial\lambda}\cdot\lambda=0, \tag{9b}$$

$$A\geq 0, N\geq 0, \lambda\geq 0, \tag{10}$$

We start with the case in which the credit constraint is not binding($\lambda=0$); solving first-order conditions (7a) and (8a) for the optimal values of A and N and differentiating yields:

$$\frac{dA}{dF}=\frac{A}{F} \tag{11}$$

and

$$\frac{dN}{dF}=0. \tag{12}$$

Equation (11) implies that in the absence of binding credit constraints, the elasticity of the optimal operational size with respect to household size is unity, i.e., there is a fixed operational holding to household size ratio. The amount of owned land does not affect the optimal ratio. This outcome is intuitively expected in a situation of constant returns to scale with perfect rental and capital markets.

Equation (12) implies that the optimal number of hired laborers per acre is not affected by household size (neither is it affected by the size of the owned holding). Since the earlier results imply that the operational holding is proportional to household size, it follows that the number of hired laborers per acre is identical on all farms, whatever the size of the operational holding (and that the ratio of family to hired labor declines with operational holding size). A trivial extension of these results is the observation that the level of effective labor per acre is identical on all farms (since the ratio F/A is fixed and N is the same on all farms), assuming all other farm and farmer attributes are identical. It therefore follows that output per unit of land operated is not affected by the size of the operational farm or by the amount of land owned.

The analysis and the presentation in the case where the credit constraint is binding ($\lambda > 0$) are greatly simplified by assuming that the functions $q(\cdot)$ and $e(\cdot)$ are of fixed elasticity with respect to their arguments, that is, that $(q'/q) \cdot (L/A) \equiv \eta$, the elasticity of output with respect to effective labor, and $(e'/e) \cdot (F/A) \equiv \mu$, the elasticity of effort with respect to supervision, and where

$$\frac{dA}{dV} = [(1 - \mu) \cdot (S' + R \frac{w}{[}(1 - \mu) \cdot (c + \frac{R}{w}] - [\mu \cdot (1 -) \cdot e \cdot \frac{F}{e} \cdot A]$$

μ and η are parameters within the interval (0,1). The standard treatment of labor in the literature - the assumption that hired labor is not affected by family supervision - is then the special case $\mu = 0$ in the present model.

Differentiation of equations (7a), (8a), (9a), under the assumption of an internal solution, yields after some manipulation

$$\frac{dA}{dV} = \frac{(1 - \eta - \eta \cdot \mu) \cdot \frac{(S' + R)}{w}}{\frac{(1 - \eta \cdot \mu) \cdot (c + R)}{w} - \frac{\mu \cdot (1 - \eta) \cdot \bar{e} \cdot F}{e \cdot A}} \qquad (13)$$

The denominator can be shown to be positive if second-order conditions hold. It follows that the sign of equation (13) is determined by the sign of $(1 - \eta - \eta \cdot \mu)$, which is the limit value of total output elasticity with respect to land as the share of family labor tends to zero.

To demonstrate that the relation between per-hectare yields and operational holding size can follow different patterns within the framework of the present model, we use the definition of effective labor and the first-order conditions to calculate the optimal per-hectare input of labor:

$$(L/A)^* = \eta \cdot \{[c+R) \cdot e/w] - [\mu \cdot \bar{e} \cdot F/A]\}/(1-\eta-\eta \cdot \mu). \quad (14)$$

Differentiation of equation 14 with respect to owned holding size V yields

$$\frac{d(L/A)^*}{dV} = \mu \eta \left[\frac{\bar{e}}{e} \cdot \frac{F}{A} - \frac{(c+R}{w} \right] \cdot \frac{e}{A} \cdot \frac{dA}{dV} / (1-\eta-\eta \cdot \mu). \quad (15)$$

Clearly, if the labor market is perfect ($\mu=0$), labor per hectare of land does not vary with farm style. Inspection of equation 13 verifies that dV and the sign of equation 15 thus depends on the term in square brackets.

In the case where $1-\eta-\eta \cdot \mu > 0$, the relation between the effective labor input per hectare and owned holding size can be negative or positive. Consider, for instance, the case where the output elasticity η equals ½. First-order conditions imply $[(1-\eta)(\bar{e}/e)] \cdot (F/A) - \eta \cdot [(c+R)/w)] < 0$, hence, in the case where $\eta = ½$, it follows that $d(L/A)/dV < 0$, i.e., the effective labor input (and yields) declines with owned holding size. The same result can be obtained for all $\eta < ½$. By an argument of continuity, since in the case $(1-\eta-\eta \cdot \mu = 0$ it holds that $d(L/A)/dV > 0$ (in that case there is a final operational farm size regardless of wealth), there must exist some low (but positive) values of the term $(1-\eta-\eta \cdot \mu)$ for which $d(L/A)/dV > 0$ holds. The conclusion is, therefore, that one may observe a positive or a negative relation between operational holding size and per-hectare yields, depending on the relative magnitudes of η and μ. In the case $(1-\eta-\eta \cdot \mu) = 0$ there will be no correlation between operational holding size and per-hectare yields.

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