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Issues for Infrastructure Management in the 1990s

Arturo Israel

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Foreword

Infrastructure — broadly defined as electric power, irrigation, transport, telecommunications, water supply, and sanitation — will play a key role in facilitating the resumption and acceleration of growth in developing countries. Well-performing infrastructure services are crucial for enabling countries to participate in and benefit from such developments as the globalization of trade. They are equally important to effective implémentation of poverty reduction programs. The close links between infrastructure services and the environment are also well recognized.

Expectations about the role of infrastructure in development have changed over time. While infrastructure's importance to development has long been understood, its impact has been blunted by other constraints that blocked or deflected its effects throughout the economy. Over the last decade, policy reform, especially in the context of structural adjustment, has brought many countries to the point where they are now able to use the resources devoted to infrastructure services more effectively for development.

The study analyzes a number of issues that are common to all infrastructure sectors. Some, such as the reliability of infrastructure services, emerge from the need to adapt those services to the stricter requirements of an open economy and to improve their performance. But most of the issues emerge from exploring the specific implications for infrastructure of the changing role of the private sector and competitive markets in the provision and regulation of infrastructure services. A dominant theme arising from this analysis is the need to reorient thinking about infrastructure away from the traditional emphasis on supply and toward demand considerations and the quantitative but also qualitative needs of users, clients, and beneficiaries.

The study summarizes much of the background work undertaken for a sectoral policy review of infrastructure. It makes several operational recommendation and proposes research priorities. Follow up work to this study constitutes an important component of the Department's research and policy activities.

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Infrastructure and Urban Development Department

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Chapter 1

Conclusions and Recommendations

Overall Conclusions

1.1 This chapter summarizes the main conclusions of the study and discusses their operational and research implications. The first, general finding is that the condition of infrastructure (electric power, irrigation, telecommunications, transport, water supply and sanitation) at end of the 1980s was broadly similar to that of a decade earlier. Most governments continued relatively high levels of expenditure, helping to increase coverage—especially in power and water and to reduce the urban-rural gap. However, the general condition of infrastructure is poor, performance standards are low, and the financial situation in most cases is still weak. Generalizations are difficult to reach because there are major differences among subsectors and countries.

1.2 Second, there is remarkably little clarity about the nature and intensity of the real, financial, and fiscal linkages of infrastructure with the rest of the economy, but the negative effects of distorted policies on returns from infrastructure investments have been reasonably well documented. These macrolinkages have been historically tackled through rigid planning—for example, in input-output models—and insufficient knowledge is available as a basis for effective macroeconomic and sectoral policy management. The interactions among the infrastructure sectors—their complementarity and substitutability—also appear central.

1.3 Third, the challenges faced by infrastructure in developing countries—trade globalization and liberalization, the increasing reliance on competitive markets, sharper production and marketing techniques, faster changes in demand patterns, increased urbanization, and expected shortages in investment capital—suggest that the way to enhance infrastructure's role in growth is mainly by increasing productivity, particularly in maintenance. To invest more to compensate for operational inefficiencies, as in the past, is unrealistic. Also, demand changes suggest that there will be increasing emphasis on the quality of services and not only on their availability.

1.4 Fourth, the measures traditionally pursued to enhance productivity have not been successful. Recent developments such as policy reforms and a changing role for the public and private sectors are steps in the right direction, but not sufficient to achieve the required increases in productivity. A new approach is needed that focuses on enhancing the demand orientation and consequently the accountability of services. By this we mean a closer attention by operators to the nature and pattern of demand—to markets—and an increased role for clients, users, or beneficiaries in the planning and operation of the services (voice). This contrasts with the traditional supply orientation of infrastructure, largely determined by the predominance of technical elements and the fact that many services have been monopolies, public-sector operated, or both. This alternative approach should be complemented with a more explicit attention to the real, financial, and fiscal linkages of infrastructure with other economic activities.

1.5 The specific components of this proposed demand orientation are: (i) a focus on the reliability of services, as a way of providing a more demand-oriented perspective to issues of

operational performance; reliability is proposed as a practical focus to deal with the issue of quality of services; (ii) an extension of competitive markets beyond what is now the case in most countries—profiting from recent institutional and technological innovations—as the simplest and most effective way of achieving a demand orientation; (iii) an expanded role for the private sector in the operation and financing of services, for a similar reason; and (iv) an expanded role for competition surrogates—particularly decentralization and voice—in the many infrastructure activities that have to remain as monopolies and/or in the public sector.

1.6 Fifth, private sector financing of infrastructure has considerable potential in many countries. However, some mechanisms such as build-operate-transfer (BOT) schemes are of limited applicability because of the absence of suitable regulatory frameworks and an unwillingness by private sector operators to share risks. Traditional and widely used methods such as concessions, self-help, or even bond financing, where feasible, are more likely to succeed and their impact can be improved substantially. Turning the focus toward these traditional methods will help the developing countries for which BOTs are not a viable alternative.

1.7 Sixth, although the link between infrastructure and the environment was not explored in detail for this paper, the study highlighted the negative environmental impact of distorted prices and badly maintained equipment and fixed facilities. Similarly, the paper did not explicitly explore the links between poverty and infrastructure services, but the scattered available evidence confirms the conclusion that inadequate and unreliable services affect the poor much more intensely—exponentially—than they affect higher-income groups. In fact, a working infrastructure might be one of the most effective poverty reduction activities.

1.8 Seventh, the concept of infrastructure is being constantly expanded, to include not only fixed facilities but also equipment and "social" infrastructure. This approach tries to present as unified a large set of activities that are quite heterogeneous. This trend ought to be reversed, to focus on more homogeneous groups. Activities that can operate in the private sector in competitive or contestable markets should be dealt with as standard industrial activities sometimes requiring regulation. Public sector attention on infrastructure should be concentrated on those public goods that need to be operated as monopolies or quasi monopolies. These public goods face difficult problems: their performance can be enhanced only through competition surrogates and, since these surrogates are less effective than competitive markets, the performance of these services is likely to always be weaker, thus requiring strong political support.

1.9 Finally, the study has identified a number of areas (listed below) about which applied research and experimentation would be desirable. Defining a research program aimed at dealing with these issues should be given high priority. Research on infrastructure in developing countries has been scarce in recent years.

Operational Recommendations

1.10 The findings point to alternative approaches that can help guide developing countries and the World Bank as they tackle infrastructure development. The set of alternative approaches should include:

1. Emphasizing improvements in operational performance, quality and reliability of services, and maintenance and rehabilitation, instead of increases in capacity through new investments.

2. Promoting competitive markets in infrastructure services, whenever possible, making sure that the institutional and technological innovations that allow competitive markets to function have been fully used.

3. Ensuring that a country has the institutional capacity to manage sectoral policies and to regulate infrastructure services, as needed. Sectoral policy management most likely will require some form of sectoral or subsectoral planning.

4. Promoting, whenever feasible, private sector participation in the operation and financing of infrastructure services; for most countries, complex mechanisms such as (BOT) schemes are unlikely to succeed, but more traditional approaches such as concessions, self-help, or infrastructure funds or banks hold promise.

5. Focusing attention and political support in the public sector on infrastructure services that need to remain public monopolies—to enhance their performance with measures such as the setting of clear rules, decentralization, and increased voice for users.

6. Including as a key ingredient of infrastructure policy management the promotion of stronger participation of users in the decisions of public sector infrastructure suppliers—particularly of those not operating in competitive markets—to give greater weight to demand.

1.11 At the Bank, these approaches could underlie the dialogue with member countries. The approaches should be reflected in the policy dialogue, but also in the preparation of *country strategies* and *country economic and sector work*. The country strategies should include an assessment of the expected role of infrastructure in the countries' development strategies. The strategies should be based on multisectoral infrastructure studies, with a perspective similar to that of this study, to assess common problems across infrastructure actors. The strategies also should be based on traditional sectoral studies and on studies of specific issues such as reliability, the role of competitive markets, regulation, and voice.

1.12 Individual *operations* could also reflect these alternative approaches. In addition, a multisectoral operation focused on one or more of the special issues discussed here—for example, reliability in the context of an export promotion cycle, the promotion of competitive markets, or decentralization—can be valuable.

1.13 Two other points are worth highlighting. First, *telecommunications* is emerging as a key sector for most developing countries. The Bank should reevaluate its relatively modest role in this sector, particularly in the context of adjustment or other operations that include privatization. Second, *regulation* is essential to assure the success of the new sector policies—and this probably is one of the most worrisome aspects of infrastructure. Regulatory problems are evident even in the best of circumstances in developed countries. The difficulties in developing countries are worse: the

conceptual basis for regulation is not well-developed, the needed institutional capacity is consistently underestimated, and political support is seldom available. Improving the quality of regulation might be the most important challenge for developing countries trying to improve infrastructure.

Research Priorities

1.14 For several reasons, such as other priorities in development strategies and a narrow focus on project analysis or sectoral planning, research on infrastructure in developing countries has been scarce. Surprisingly little is known about the specific effects of infrastructure; about the effects, nature, and extent of externalities, and about the nature of macrolinkages. Comparative data among countries are rare, inconsistent, and unreliable. The Bank should take the initiative to help set a research agenda as soon as possible. Several priorities emerge from this study.

1.15 First, more needs to be known about short- and long-term effects. One aspect would be the linkages of infrastructure with the rest of the economy. The scarce research that has been conducted has little—if any—policy application. A large research agenda can be defined around effects—for example, variations in effects of infrastructure according to regions' economic structure, population, and economic densities; effects of infrastructure at different stages of development; effects on different units—households, productive units, communities; effects of changes in the structure of demand—such as trade liberalization or elimination of locational subsidies—on infrastructure services; dynamics of interaction and sequencing among infrastructure investments; and so on. Other considerations are the externalities of infrastructure on the environment and on poverty reduction—and long-term aspects such as the shape and density of urban areas. Research also could help separate the differing effects on growth of the quantity, diversity, and reliability of services. For individual projects or groups of projects, the methodology of cost-benefit analysis also needs to be improved through the inclusion of as many factors as possible—for example, the environment—and of distributional and fiscal effects. Decisions are constantly being made about these issues without adequate knowledge.

1.16 A second, new area of research should cover technical, institutional, and political ways of extending competitive markets and also the possibilities of private sector participation. For example, consideration should be given to redirecting technical research to these two objectives instead of treating technological progress as exogenous. More systematic research is needed to assess the potential of specific institutional solutions under different circumstances. For example, the low potential of BOT schemes suggests the need for more research on them, in light of their apparent popularity. Also, for the remaining public monopolies, more research is needed about the potential of decentralization and voice.

1.17 A third research area should be the design and implementation of regulation for infrastructure—beginning with a detailed assessment of recent experience in developed and developing countries. A conceptual framework needs to be developed for the management of sectoral policies including, for example, sets of performance indicators. In fact, policy management and research are seriously hampered by unreliable data. The Bank should consider whether to help produce an infrastructure data bank or develop other solutions to assure reliable intercountry comparisons. At a minimum, the Bank should record comparable information on its operations.

1.18 Last, more research is needed on the reliability and quality of infrastructure services, particularly in the context of intersectoral infrastructure operations, such as trade logistics.

Chapter 2

The Current Status of Infrastructure

Introduction

2.1 Infrastructure (defined in the next section) faces a number of challenges during the 1990s. The first is to support the resumption of growth after a decade of stagnation in many developing countries. Many of these have gone through adjustment processes resulting in considerably restructured economies, more consistent economic policies, less distorted prices, and an ongoing process of public sector restructuring. However, the supply response to adjustment has not been as strong as expected, in part because of inadequate infrastructure services. Second, the productivity of infrastructure is key in determining the way in which countries will deal with global trends such as the increasing pace of urbanization, the opening up of the economies, the globalization of trade, and technical innovations in manufacturing and logistics. Third, growing concerns with the environment and poverty reduction also are heavily linked to the productivity of infrastructure. These challenges look particularly daunting because infrastructure in developing countries is alleged to be in a "crisis," in the sense that a shortage and deterioration of services and investments are seriously interfering with the achievement of development objectives.

2.2 Infrastructure has had a varying role in development strategies. In the 1950s infrastructure, transport in particular, was given a central role: if governments were to provide infrastructure, economic growth would greatly accelerate, a view heavily influenced by the experience of developed countries. But this assumption became discredited by experience: in most cases infrastructure was not sufficient to ensure growth. Other measures were necessary, such as investments in directly productive activities or in human resource development. Infrastructure became secondary or subsumed in other factors (although infrastructure investments have continued at fairly high levels). The relatively lower priority assigned to infrastructure in development strategies reached its nadir with the switch to a focus on macroeconomic and sectoral policies. Inevitably, this emphasis on the macro-variables pushed the priority given to infrastructure closer to the bottom; this is where it seems to be now.

2.3 Policy reform programs during the 1980s have resulted in infrastructure services facing a more consistent set of macroeconomic and sectoral policies and a reduction in their expected direct distributional role. Services are beginning to operate in more competitive and less regulated markets; many are being privatized or operated by the private sector. Most of these developments are recent and their impact still hard to assess, but they are potentially important developments, because distorted policies and prices make most attempts at operational improvements ineffective or counterproductive. The stage is now set for achieving substantial improvements in the productivity of infrastructure services.

2.4 The purpose of this paper is to analyze a selected number of issues considered key to enhancing the productivity of infrastructure services in the 1990s. The paper attempts to look at infrastructure as a whole, reviews recent developments, highlights new insights emerging from subsectoral or country comparisons, illustrates successful approaches, and proposes a number of measures aimed at increasing the productivity of infrastructure services that could be of use to developing countries, the Bank, and the development community.

2.5 This chapter defines infrastructure, reviews its current status, and contains a brief overview of the Bank's role in infrastructure. Chapter 3 discusses what is known about infrastructure's effects on the economy—including effects on poverty and the environment. The issues surrounding reliability and how it may be used to improve productivity are covered in Chapter 4. Chapters 5 and 6 review approaches for reorienting the management of infrastructure toward demand—using markets and the private sector where possible—including some private financial mechanisms. Competition surrogates are discussed in Chapter 7.

Infrastructure Characteristics

2.6 All definitions are conventions. The more literal definition of infrastructure, which refers to fixed facilities or installations, does not provide a sufficient basis for deciding from an operational point of view which sectors to include. The Bank's administrative organization into infrastructure divisions or departments reflects historical convenience or accident and does not provide a workable approach for deciding on this matter. Few, if any governments use "infrastructure" as a way of organizing their administrative services. However, the test of the usefulness of a definition is whether there is a group of sectors which share common characteristics and problems to a sufficient degree to justify their being lumped together for analytical purposes. Not all the sectors chosen need to share all the characteristics or problems, but there should be significant elements of commonality. In this paper, the services provided in the following five sectors have been included: (i) electric power, (ii) irrigation, (iii) telecommunications, (iv) transport, and (v) water supply and sanitation, both in the urban and rural dimensions.

2.7 Infrastructure services result from combining physical facilities, hardware— vehicles and equipment—and other inputs. The focus of this paper is on those services and not only on the physical facilities.

2.8 Traditionally, infrastructure has been provided mainly by the public sector and has the following other characteristics: considerable lumpiness in its investments; economies of scale, resulting in monopolies; high level of externalities (positive or negative); intermediate input characteristics; important network effects; and difficulties in recovering costs. This characterization is still generally accurate but distinctions must be made, for example, between urban, rural, and inter-urban infrastructure; trunk and feeders; fixed facilities and moving ones; and facilities operated by enterprises—public or private—or by central government agencies.

2.9 Infrastructure may be examined from several perspectives. For example, from a *maintenance* perspective, there is a spectrum of fixed facilities according to their usage. At the simpler extreme, fixed facilities combined with fixed machinery—a thermal power plant or a

telecommunications center—are the easiest because their maintenance is related mainly to normal wear and tear. At the other extreme, highways require the most complex maintenance because the wear and tear is related not only to factors such as time, geographical dispersion, and climatic conditions, but also to usage by a heterogenous fleet of vehicles with different axle-loads and with potential overloading. Maintenance of other fixed facilities is simpler. A railway track carries more homogeneous vehicles—and, institutionally, the provider of the fixed facilities has owned the vehicles, at least until now. Fixed facilities that transport water also have relatively simple maintenance needs. In fact, from this—and other—points of view these subsectors can be grouped into the "water cluster," the "machine cluster," and the "vehicle cluster."

2.10 From the point of view of *demand*, highway infrastructure is the most complex: road transport interacts with a large number of sectors, has high network effects, and is a widespread intermediate input. Other complications are the lack of direct contacts between suppliers (highway departments) and users, and the difficulty of operating highways—as distinct from road transport—competitively. On the other hand, in activities—such as telecommunications or railways—run by enterprises in which suppliers are in direct contact with users, the potential for operating in competitive markets is higher and the activities are in a much better position to respond to demand. Some subsectors have a locational monopoly that enables them to largely disregard demand, especially in thin markets—for example, airports, ports, and water supply.

2.11 In terms of *competitive markets*, relevant factors are the lumpiness in investments, economies of scale, the demand structure, the linkages between users and suppliers, and the complexity of the required institutional and managerial structures. At one extreme are activities that clearly could operate competitively and in the private sector—such as urban transport. An example at the other extreme is large water supply systems, for which, with few exceptions, a competitive private-sector environment can't be created. Other subsectors in a similar, but not as extreme, situation are waterways and major water storage facilities. The other subsectors fall in-between. A corollary to this analysis has to do with the degree of *government intervention*. Taking only the potential for monopolistic conditions (encompassing lumpiness, long asset life, and economies of scale), externalities, and potential for cost recovery, highways again appear extreme, needing a high level of government intervention—as do other activities such as major irrigation systems and dams. At the other end, telecommunications, road transport, or thermal power generation seem to require a minimum of intervention relative to other infrastructure subsectors.

2.12 This preliminary analysis suggests a spectrum of infrastructure subsectors ranging from those in which policy or institutional solutions are extremely difficult, to those in which the technical aspects are relatively simple and lend themselves to efficient operation in a competitive market—in public or private hands—with minimal regulation. Highways—especially urban and interurban—require the most difficult solutions. Other fixed infrastructure, such as major irrigation or water storage facilities, has less acute but similar characteristics. And although the potential for operating railways competitively is high, they have complex managerial needs. Maintenance is a key issue for all infrastructure because institutional, financial, and political factors conspire to consistently underestimate and underfund maintenance. Thus, a complex maintenance function implies an exponentially more complex maintenance operation.

2.13 From an operational perspective, a clearer distinction ought to be made among these different groups of infrastructure activities. Activities that have few traditional infrastructure characteristics ought to be treated like commercial or industrial activities. Conversely, for activities that have many of the complex characteristics of infrastructure, countries will have to look for the best possible public sector role—and one that needs to be strengthened.

The Bank's Experience in Infrastructure

2.14 A comprehensive review of the Bank's experience in infrastructure will be provided in a forthcoming policy paper. But three key trends are germane to this analysis.

2.15 First, in spite of the well-publicized changes in development strategies, infrastructure has continued to represent between one-third and one-half of Bank1/ lending since fiscal 1975 (Table 2.1 and Appendix Tables A.1 and A.2). In real terms, infrastructure continues to be most important, but its composition has changed. The importance of transport has declined while that of electric power has increased considerably. In fiscal 1970-79, transport lending was 38 percent of infrastructure lending, electric power, 28 percent; and water and sanitation, 10 percent. In fiscal 1980-89, the percentages were 27, 34 and 10 percent, respectively.

2.16 Second, infrastructure operations have performed better than average, with 85 percent of all infrastructure projects analyzed by the Operations Evaluation Department judged to be satisfactory, compared with a Bank average of 77 percent (Table 2.2). Telecommunications was the best sector—with 96 percent satisfactory—and irrigation the least favorable, with 25 percent. The *ex-post* rates of return for these sectors have been consistently higher than the Bank averages, particularly for telecommunications and highways, often by significant amounts (Appendix Tables A.3 and A.4). The outcome of the institutional development objectives in those operations, however, has been less favorable. Of the 1,250 projects with *institutional development* components reviewed by OED in 1978-87, only 36 percent were considered to have achieved substantial success, although infrastructure had higher success than most projects in other sectors. For example, utility projects achieved substantial success in 42 percent of the cases (Table 2.3). Even in the sector with the lowest level of substantial and partial achievement—agriculture—the success was greatest in irrigation. A more detailed review of 40 infrastructure projects reports that in more than 52 percent of the projects, the treatment of institutional development was rated good, compared with projects in other sectors for which the figure was 38 percent (Appendix Table A.5). Because sustainability requires the achievement of institutional objectives, it is not surprising that the outlook for sustainability is also relatively low—although again better for infrastructure than for other sectors. Of 320 infrastructure projects evaluated by OED in fiscal 1986-90, only 59 percent were considered likely to be sustainable, largely because of institutional problems. That figure was still better than the 51 percent average Bank-wide.

1/ Bank includes IBRD and IDA.

Table 2.1
World Bank Lending for Infrastructure[1/]
(in millions of 1987 U.S. dollars)

Sector	1970-79			1980-89		
	Amount	% Share of Total Lending	% Share of Infra-structure Lending	Amount	% Share of Total Lending	% Share of Infra-structure Lending
Irrigation	8,087	7.9	15.0	11,079	6.6	14.8
Electric Power	14,909	14.5	27.7	25,553	15.2	34.2
Telecommunications	3,079	3.0	5.7	2,348	1.4	3.1
Transport	20,225	19.6	37.5	20,001	11.9	26.7
Urban Transport	2,259	2.2	4.2	8,497	5.1	11.4
Water Supply & Sanitation	5,341	5.2	9.9	7,331	4.4	9.8
Total Infrastructure	53,900		100.0	74,809		100.0
Total Bank Lending	103,015			167,625		
Infrastructure Lending as Proportion of Total Lending	52.3			44.6		

Note: Some figures do not add up to totals because of rounding.
Source: World Bank data.
[1/] Bank includes IBRD and IDA.

Table 2.2
Bank/IDA Projects
Performance Evaluations, 1974-90

Sector	No. of Projects Evaluated	Percentage Rated Satisfactory
Irrigation	163	75
Electric Power	220	92
Telecommunications	72	96
Transportation	463	83
Water and Sewerage	132	86
Total Infrastructure	1,050	85
All Bank Projects	2,587	77

Source: Operations Evaluation Department.

Table 2.3
Achievement of Institutional Development Objectives:
Operations Evaluation Department 1978-87
(percentages)

Sector	Substantial	Partial	Negligible
Utilities	42	42	15
Transport and Urban	34	45	20
Agriculture	33	42	25
Industry	48	32	20
Development Finance Companies	40	45	15
Education	31	56	18
Human Resources	23	54	23
Total	**36**	**45**	**19**

Source: Operations Evaluation Department.

2.17 Third, the Bank approach to infrastructure operations has evolved like that for other sectors. Initially, infrastructure operations were purely investment oriented—with only modest institutional development components, focused mainly on the implementing agency. Projects used conditionality—often unsuccessfully—to impose financial discipline and also generally supported public ownership and operation of public services. This initial focus has been broadened to encompass sectoral operations geared to policy reform and sector- or subsector-wide institutional reform programs. These broader operations have tried to address the real, fiscal, and financial linkages of infrastructure with other economic activities. There are, of course, important variations among infrastructure sectors.

Infrastructure at the End of the 1980s

2.18 This study assessed infrastructure in the late 1980s in developing countries using three major sources: the Bank's sectoral data banks, Bank sectoral reviews, and detailed information on nine countries—Bangladesh, Brazil, Colombia, Hungary, India, Kenya, Nigeria, Morocco, and Thailand (see Appendix Table A.6 for a full treatment). These countries illustrate widely varying infrastructure status in all major regions, at different income levels, and of differing sizes and population densities. The data have serious limitations, however. First, for some countries and sectors the most recent data are generally for 1985-87—although it is doubtful that the situation has changed dramatically since then. Second, the data are not consistent enough to facilitate comparison of the 1980s situation with that of the 1970s—thus, the general conclusion that progress in improving infrastructure in the 1980s was slower than in the 1970s cannot be statistically verified. In addition, the margin of error is large; the concepts of infrastructure, operational efficiency, and financial viability are not always consistent among countries or sectors; and monetary data are rarely adjusted

for inflation. Because of these shortcomings, the review was supplemented by extensive interviews with Bank staff.

2.19 In most respects, the review found the status of infrastructure was not greatly changed in the late 1980s from a decade earlier: poor conditions, low performance standards, and weak finances were still the norm. Although, even during adjustment, many governments continued high levels of spending for infrastructure—usually not as high as before—others did not. Spending ranged from substantial investment in East Asia to reductions in some countries in Africa and Latin America. Partly because of differences in spending volume, services vary among countries and subsectors. Some countries were able to expand coverage and reduce the urban-rural gap. And supply exceeded demand where growth was slower than expected. Yet despite increased spending, infrastructure in East Asia generally has not been able to keep up with demand. The type of spending also varied. Some countries maintained service levels by increased investment in new capacity alongside a deteriorating stock. And, whatever the reason, infrastructure generally has responded slowly to new demand. Adjustment and policy reforms—countrywide or sectoral—have not yet greatly affected services, prices, or financial condition.

2.20 Whether this scenario constitutes an infrastructure crisis is largely a matter of perception. Infrastructure was not a major barrier to growth in the 1980s—particularly in stagnant or declining economies. But what could indeed qualify as a crisis is that infrastructure in its present condition will prove a major barrier to future growth, when other barriers have been eliminated. This crisis differs from that in several developed countries, in which a previously adequate infrastructure has been allowed to deteriorate due mainly to lack of funds instead of serious operational problems.

2.21 ***Expenditure and coverage.*** This study reached four conclusions about expenditure and coverage. First, public sector expenditure in infrastructure in the 1980s continued in real terms at levels higher than in the 1970s. Second, as a consequence, the increase in infrastructure services during this period was generally sufficient to meet the increase in demand from population growth and from higher income—when such an increase occurred. Third, investment also allowed infrastructure to reach a larger share of the population. But, fourth, available capacity was seldom well utilized.

2.22 A study of 53 countries indicates that government investment for infrastructure was generally higher in real terms in the 1980s than in the 1970s (Table 2.4), and even adjusting for population increases. The nine-country study and sectoral information generally support this conclusion. In a study of road investments in 35 countries, central government capital expenditures in real terms increased in 23 of them in the 1980s compared with the 1970s, and the country studies do not indicate any broad slowdown in road investments by the mid-1980s. In the 1980s, the United Nations made a special effort, the *Water Supply and Sanitation Decade*, to expand these services. Annual investments increased 50 percent in real terms from about $6 billion in the early 1980s to $9 billion by the end of the decade. The capacity of *telecommunications* systems also was substantially expanded. A study of 18 developing countries

indicates that investments increased from $4.6 billion in 1979 to $5.5 billion in 1988 (in 1992 prices). Investments were higher in 11 of the 18 countries. However, a study of *ports* in 16 countries shows no significant difference between investment levels in the 1980s and 1970s. The country studies also found that *road* networks were expanded and improved in all countries, that traffic generally increased at 5 to 10 percent annually, and the number of vehicles continued to grow rapidly. Network expansions in the first half of the 1980s generally ranged between 5 and 20 percent for most countries. In five of the seven countries for which comparative data are available, the network increases were greater or similar to those in 1975-79.

Table 2.4
Central Government Capital Expenditures in Infrastructure
During 1970s and 1980s
(in real terms)

Sector	Number of Countries						
	Total Capital Expenditure	Roads	Rail, Pipe-lines	Ports	Energy	Water	Tele-comm.
Total No. of Countries	53	35	24	16	18	17	20
No. of Countries Where Capital Expenditures Were							
Higher in the 1980s	32	23	11	7	12	14	14
Lower in the 1980s	21	12	13	9	6	3	6
Compared With 1970s							

Note: Average annual expenditures in 1987 prices in 1975-79 and 1980-89 are used for comparison of expenditures in the 1970s and 1980s.
Source: IMF Government Finance Statistics Yearbooks

2.23 The supply of *power* increased considerably in the 1980s. A study of 70 developing countries indicates that it reached about 2,000 TWh (Terrawat-hours) in 1989, more than double the level of 1980 (Moore and Smith 1990). Annual electricity consumption increased between 1980 and 1987 from 470 Kwh to 650 Kwh per person in 41 developing countries. In the nine countries studied, power generation and consumption increased at annual rates ranging from 5 to 13 percent, lower than the increases of the 1970s, reflecting mainly lower economic growth. Several countries—particularly Bangladesh, Brazil, and India—faced power shortages in spite of large expenditures, partly because of investments that were not balanced between generation and transmission. In *telecommunications*, in spite of the higher investments, capacity in most countries is insufficient—causing congestion, reduced service quality, and annual losses to the economy estimated in some countries at more than the annual investments in telecommunications. Unmet demand for telephone connections in the developing countries might exceed 20 million compared with about 43 million service connections (Wellenius 1990). A study of 28 developing countries indicates

that between 1977 and 1987 waiting lists have increased, or remained essentially unchanged in 22 of them (Appendix Table A.7). In 1988, telephone waiting periods in a study of 18 countries averaged about 10 years.2/ Finally, *port* traffic increased in all nine countries studied in detail. Capacity has been adequate to handle general cargo traffic, but ports have not adjusted fast enough to the rapid increase in container traffic.

2.24 As a result of investments and increases in supply during the 1980s, access to infrastructure services has continued to increase, with a growing proportion of people in most countries having access to electricity, safe water, telephones, and transport. The gap between urban and rural populations remains large, but has declined somewhat. The population having access to electricity increased between 1980 and 1990 from 35 to 43 percent, but grew faster in rural areas (from 27 to 33 percent) than in urban ones (from 70 to 74 percent), thus closing the gap slightly (Table 2.5). In water supply, by 1990 about 69 percent of the population had access to safe water, about 63 percent in rural areas and 82 percent in urban. This was a significant improvement over 1980, when rural access amounted to only 30 percent and urban access 77 percent. As a result, almost one billion more people in rural areas had access to safe water.3/ Access to water increased in seven of the nine countries—but not in Bangladesh and Colombia—but many cities faced water shortages severe enough at times to require rationing. Service deficits tended to be concentrated among the poor. More generally, in an increasing number of countries, especially in East Asia and Latin America, nearly all people in urban areas have some access to electricity and water supply. Access to telecommunications, however, is still relatively low in spite of increased capacity. A study of 13 countries shows that in 1989 the number of telephones ranged from 0.5 telephones per 100 people (India) to 18 (Portugal), compared with 40 to 60 in developed countries overall.

Table 2.5
Access to Infrastructure, 1980 and 1990:
Rural and Urban Population Covered
(in percentages)

Sector	Urban		Rural	
	1980	1990	1980	1990
Power	70	74*	27	33*
Water	77	82	30	63
Sanitation	69	72	37	49

Source: World Bank Databases; and U.N. Report of the Economic and Social Council, July, 1990.

2/ International Telecommunications Union, Pyramid Research, Inc.

3/ U.N., Report of the Economic and Social Council on Achievement of the International Drinking Water Supply and Sanitation Decade, 1981-1990, July 1990. The effectiveness of this "access" is hard to assess. Many of these new systems become quickly non-operational and in need of rehabilitation, or access is hampered, for example, by deficiencies inside dwellings. These figures are likely to be overestimates.

2.25 Although expansion of infrastructure capacity has continued, it has not been equally well used. The existing capacity is generally adequate—or even exceeds demand—for roads in Africa, railways in Africa and in Latin America, for port capacity to handle general cargo, for power in many countries, and for water supply in some countries. The major reasons for excess capacity include the unanticipated slow increase or decline in demand because of stagnating economies in the 1980s and—for a few sectors—the long-term decline in demand that has not been matched by reduced capacity (for example, in railways and port capacity for general cargo traffic). Excess capacity is sometimes the result of investment imbalances, as between power generation and transmission and distribution, or when irrigation capacity is wasted because of inadequate investment in canals. On the other hand, the existing capacity is fully used or fails to meet effective demand for roads in many countries in Asia and in some Latin American, European, Middle Eastern, and North African countries, and at peak hours in most large urban areas; for railways in most Asian and Eastern European countries; for power and water supply in some countries, particularly China and India; for telecommunications; and for port capacity to handle container and bulk traffic in almost all countries.

2.26 *Railways* continue to be a special case. Most have lost traffic in the 1980s although China and India are important exceptions, for well-known reasons. The decline has been sharpest for passenger traffic because of the continuing expansion of roads. In most of the nine countries studied, the railways could carry more traffic with relatively small additional investments. Investment data are not readily available but the level of investments by central governments in railways, pipelines, and air transport combined did not differ much in the 1980s from the 1970s, suggesting a decline in railway investments.

2.27 ***Infrastructure condition and performance.*** The condition of infrastructure continues to be poor and to deteriorate in a number of cases. For example, the vast expansion and improvement of *roads* in developing countries in the 1960s and 1970s "created an infrastructure that has been crumbling in the 1980s and threatens to collapse in the 1990s if not quickly strengthened and protected" (World Bank 1988, p. 5). In 85 countries, 26 percent of the paved network is in poor condition and requires rehabilitation and reconstruction and 42 percent is in fair condition, requiring resurfacing if these roads are not to decline to poor condition (Box 2.1). The condition of unpaved roads is even worse, with 33 percent in poor condition. Regional differences are not very large, except that roads are in particularly poor condition in South Asia because of a rapid growth of traffic on roads built to obsolete standards. In many countries extensive new construction offset the deterioration that resulted from insufficient maintenance. Subsectors with a rapidly changing role seem to be in the most precarious condition. *Railways*, for example, are in generally poor condition in Africa, Eastern Europe, and Latin America—and somewhat better in Asia.

2.28 Operational standards have remained largely unchanged. The infrastructure sectors suffer from serious operational inefficiencies, including excessive labor, high losses, low reliability, and inadequate maintenance—and there is no evidence of significant improvement in the 1980s. In developing countries, *ports* averaged about 13 tons of break-bulk cargo per ship-hour, compared with 23 tons in industrial countries. For containerized cargo the difference was even greater—36 tons compared with 100 tons (Hickling 1990, Table 17). *Telecommunications* systems in many countries are frequently congested and a large proportion of attempted calls is not completed. In Morocco, only 20 to 30 percent of peak intercity and international calls were completed. Annual faults averaged 0.9 per line in service, nearly double an acceptable level.

Box 2.1
Condition of Roads

The Bank Road Deterioration Study (1988) of 85 countries observes that more than one-fourth of the paved network—about 270,000 kilometers—is in poor condition, and needs rehabilitation or reconstruction. More than 40 percent of the main paved network is in "fair" condition, and likely will deteriorate faster into "poor" condition, unless some remedial measures are taken to change the current maintenance practices .

Road Condition, by Region, 1984
(in percent)

	Paved			Unpaved		
	Good	Fair	Poor	Good	Fair	Poor
Eastern and Southern Africa	42	32	26	42	30	28
Western Africa	52	23	25	20	36	44
East Asia and Pacific	20	59	21	41	34	25
South Asia	19	45	36	6	39	55
Europe, Middle East, & N. Africa	41	35	24	30	46	24
Latin America	44	32	24	24	43	33
Average	32	42	26	31	36	33

More than one-third of the main paved network and more than half of the unpaved network in South Asia are in poor condition. The proportion of roads in "fair" condition is high, particularly in parts of Asia. The condition of such roads is likely to deteriorate to "poor" without adequate maintenance.

The Bank study points out that the variations in road conditions stem from differences in maintenance requirements and country response to such requirements in the past. The maintenance needs are determined by traffic and age of network, among other things. For example, the networks in Western Africa are relatively new, remaining in "good" condition, but are not likely to remain so beyond the next decade without adequate maintenance. The networks in South Asia consist mainly of aging roads, not built to meet the needs of current heavy traffic in terms of traffic volume, and axle loads. Consequently, many of these roads require not only normal maintenance and rehabilitation, but also upgrading. The extent to which past maintenance requirements have been met explains the present condition of the networks.

Country response to maintenance needs (and consequently road condition) depends upon financial capacity to pay for road maintenance and institutional capacity to effectively and efficiently use available funds for road maintenance. Road networks in some Latin American countries have been deteriorating rapidly, due to the economic slump in the 1980s, and the resultant financial constraints. In Brazil, the proportion of the road network in poor condition climbed from 18 percent in 1979 to 28 percent by 1984, while the proportion of roads in "good" condition increased from 24 to 30 percent, because of new construction. For want of adequate maintenance, some 6,000 km of roads in "fair" condition deteriorated to "poor" condition in five years. In Honduras, inadequate maintenance necessitated by financial constraints led to the drop in the percentage of roads in "good" condition from more than 80 percent in 1981 to about 50 percent by 1984. The networks in many Sub-Saharan African countries are relatively young and are still in the "grace period during which they need little maintenance" and do not show effects of inadequate maintenance. Chronic undermaintenance, however, could result in diminution of the road network.

Source: World Bank: Road Deterioration in Developing Countries, Chapter 1, 1988.

2.29 The efficiency of many *electric power* companies did not improve in the 1980s. A study of about 100 countries indicates that power losses averaged 18 percent of net generation in 1980 and 1987 and the number of consumers per power employee remained at about 70. In Nigeria, for example, system losses were a very high 35 percent, of which 15 percent were technical losses and 20 percent due to poorly maintained meters, theft, and underbilling. The quality of service, including reliability and losses, of many *railways* is frequently low and is not adequately tailored to shipper needs. A study of 26 railways indicates that they were not able to increase their efficiency in the 1980s.4/ But there are wide differences. For example, the turn-around time of freight cars—the time from one load to the next—averages only three days in China, but averages 25 to 30 days in many African countries.

2.30 In *water supply*, losses are generally high and Bank efforts to help reduce them have not succeeded. In Brazil, water losses averaged 29 percent in 1987. Losses were also high in India, quality was unsatisfactory, and the supply often was interrupted. In Nigeria, most water-treatment works were unreliable because of frequent equipment failures—so that water quality was poor. In *irrigation*, water distribution and application are frequently inefficient, unreliable, expensive, and inequitable—as found in five of the country studies. As a result, cropping intensity and yields are well below their potential. There are also extensive losses of production from waterlogging and salinity. The operation of the irrigation network in India has deteriorated considerably in recent years (see Box 2.2). In Morocco, the water efficiency in the Bank-assisted Doukhala project was about 50 percent, compared with an appraisal estimate of about 65 percent.

2.31 The issue that continues to emerge as central is inadequate maintenance, although the degree varies widely among sectors and countries. Current studies give several reasons to explain this shortcoming: insufficient funds and import restrictions in railways; inappropriate maintenance facilities, a shortage of spare parts, an inconsistent policy on equipment maintenance in ports; and insufficient funds and shortages of skilled personnel in water supply and sewerage (see Chapter 7). Inadequate equipment is a common problem. For example, rudimentary signaling and telecommunications systems in railways; inappropriate and excessively costly technologies in water supply; and the low penetration of modern technology in telecommunications. Bad initial construction is believed to have compounded the problem in irrigation, water supply, and ports.

2.32 ***Weak effects of reforms.*** Of the policy and institutional reforms that are of particular interest to infrastructure, the elimination of price distortions, elimination or reduction of subsidies and subsidized services, and a concern for the financial health of enterprises and centralized agencies are among the most important. (Other objectives, such as a larger role for the private sector or deregulation are discussed in Chapter 5). Improved finances of infrastructure operators and a less-distorted price structure are essential but—unfortunately—there is little evidence that such changes have occurred (Appendix Table A.6). Instead, first, some subsectors that have maintained their monopolistic position—telecommunications and most ports—continue to be financially sound. But other monopolistic subsectors such as electric power have seen their financial position eroded largely

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4/ Hickling 1990, Table 16 and World Bank Railway Database.

Box 2.2
India: Irrigation Sector - Condition, Operation, and Finance

The irrigation and drainage infrastructure in India is deteriorating in all the states, except in Punjab. The minor, branch, and major canals; control structures; and linings need repairs or reconstruction. The poor construction quality of many dams poses serious risks for downstream populations.

The poor quality of construction—particularly of recent projects—and inadequate maintenance are believed to have caused the unsatisfactory condition of the irrigation structures. Financial pressures and local pressure groups' encouragement of shortcuts (in contracting procedures, the thickness of linings, in the curing of cement) and ignoring poor construction quality are two factors behind the decline in construction quality. Maintenance has been a low priority in most states. Silt deposition, weed infestation, broken linings, and malfunctioning and damaged structures—evidence of poor maintenance—are noticeable in most surface schemes. Pumping equipment in many tubewells are in a state of disrepair. Such poor maintenance rapidly increases government recurrent costs.

The financial performance of the sector is deteriorating and has become a financial drain on many state government treasuries. At the time of independence, irrigation made a net contribution to government finances. Revenues from water charges exceeded government expenditures for operations and maintenance and imputed interest on investment costs. But, by 1980s irrigation subsidies (excluding capital amortization) are estimated to have totaled about 70 percent of total subsidies to agriculture in 1986-87. The accelerating pace of financial deterioration of the major and medium irrigation projects is clearly depicted by the following table.

Revenues and Expenditure —Major and Medium Irrigation

Expenditure/Revenue	1980/81	1988/89	% Change
Current expenditure	3.9	15.0	+280
Current revenues	0.9	1.1	+ 29
Current revenue/current expenditure	22.0%	7.5%	

Poor financial performance of the sector stems from slow growth of water charges, rising current expenditures, inadequate funding of maintenance, and increasing investment costs. Water charges are infrequently revised, resulting in erosion of value in real terms over time, and collection rates have declined, compounding the problem. Poor service provided by many irrigation commands, and poor assessment and collection procedures are behind this state of poor cost recovery. Campaign promises of politicians seeking forgiveness of nonpayment or to hold down rates add a political dimension to the problem of sector finances. Second, the sharp increases in current expenditures are primarily due to growth in total irrigation department wages—mostly attributable to growth in staff numbers, instead of better maintenance. In Punjab, where maintenance has been relatively good, 85 percent of current expenditures in the irrigation sector in 1986-90 were for staff wage bills. In the same period, identifiable maintenance expenditures decreased by 40 percent. Staffing costs increased by about 150 percent from 1980-81 to 1984-85 in Bihar, while expenditures on maintenance-related works declined slightly during the same period.

Note: Based on Irrigation Subsector Review, Agriculture Operations Division, India Department, 1991.

because of more intensive political control of tariffs than in previous periods. Second, railways continue to suffer from weak finances largely because they are exposed to competition but don't have enough operational independence. Third, charging for water supply and irrigation continues to be an operational and sectoral problem. Fourth, countries have generally managed to collect user charges to cover road operating costs, but trucks do not cover the costs they incur.

2.33 *Ports* have generally managed to maintain a sound financial position through monopolistic pricing and other measures. But competition is increasing for many ports. Tariffs often don't reflect the costs of various services—and there is a danger of financial difficulties if tariffs are not restructured to reflect the growth of container and bulk traffic. In the nine country studies, port revenues covered operating costs, the only exception being Nigeria. The financial situation of most *telecommunications* agencies is sound, given their monopoly position and demand in excess of supply. Financial rates of return tend to approach 20 percent and the annual return on net revalued assets averaged 14 percent in a study of ten countries. In a study of 37 countries, cost recovery averaged 172 percent.5/ In fact, telecommunications agencies often are an important source of public funds. In Morocco, the system was expected to transfer $2.1 billion to the government—60 percent of gross revenue—in 1987-94 (Wellenius 1990, p. 3). Financing problems can arise, however, from the high foreign exchange costs of these investments.

2.34 A study of *electric power* utilities who were Bank borrowers in 29 countries showed that in 1987-89, only six of them earned at least 8 percent on their investments and—for 13 borrowers—rates of return had declined since the 1970s (World Bank 1989b, para 28. Thus, the proportion of investment requirements that could be financed internally declined from 25 to 17 percent (WDR 1988, p.142). The companies in only two of the nine sample countries were in a strong financial condition. Most *railways* continue to run heavy financial losses which impose a heavy burden on government budgets. A review of 21 railways showed operating ratios generally exceeding 130 percent and only railways which were still the dominant freight mode—because of the country's policy decision to protect railways—had significantly lower operating ratios, which still exceeded 100 percent.6/ The losses tended to be particularly high for passenger services. The practical result was the well-known vicious cycle of railways: delayed modernization, inadequate maintenance, poor services, and traffic lost to roads.

2.35 In *irrigation*, water charges often do not cover the costs of operations and maintenance and are not related to the value of water used. Low collection rates encourage wastage of water, causing salinization, high water tables, and erosion. Low charges also lead to inadequate funds for maintenance and increase the burden on government budgets. In India, for example, recovery rates rarely exceed 70 percent of operating costs. The tariff structure for *water supply and sewerage* services in most developing countries is not related to costs—and revenues rarely finance a reasonable proportion of new investments. Moreover, there are extensive losses from theft, inadequate metering, and a failure to bill and collect promptly. Cost recovery in urban areas is much

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5/ Hickling 1990. Table 3 and World Bank database.

6/ Hickling 1990. Table 18 and World Bank Railway database.

higher than in rural ones. By and large, the poor financial condition in water supply reflects the view of many governments and societies that water should be free of charge.

2.36 For *roads*, the overall level of user charges is adequate to cover actual expenditures. A study of 14 countries indicates that in the mid-1980s road user revenues exceeded expenditures in ten of them by margins ranging from about 20 to 35 percent. If maintenance expenditures had been increased to adequate levels, revenues would still have exceeded expenditures (Heggie and Quick 1990). Heavy trucks, however, rarely pay fully for the additional costs they impose on road construction and maintenance. Thus, it is likely that other vehicles are paying too much. What is not considered in these calculations is the proportion of charges that should be defined as general revenues and as such deducted from the road revenues. If this adjustment is made, the financial situation of roads is less favorable.

2.37 ***Variation among countries and subsectors.*** Clearly, there is a wide variety in infrastructure among sectors, subsectors, and countries. This section has generalized about trends as much as possible, but a few additional points can be made about sectoral and country groupings.

2.38 First, a number of subsectors have had dynamic growth in most countries, often in spite of negative general economic conditions: telecommunications, road transport, container traffic in ports, and airports. Demand for these services has grown fast and often countries have not been able to supply the necessary services. All indications are that demand for these services will continue to increase rapidly, especially if countries resume fast growth. Conversely, railways and general freight traffic in ports have continued to decline, reflecting structural changes in their roles. Water supply, sanitation, and irrigation have had a mixed record and are more difficult to classify. Water supply has been a dynamic sector but the actual demand is difficult to gauge because of price distortions.

2.39 Second, despite the wide variations among countries—depending on factors such as income level and stage of development, size, population density, economic and political structure, and urbanization—five country groupings can be identified:

- High-growth countries in Asia and now in Latin America—Chile, Indonesia, Korea, and Thailand. These countries will continue to experience high demand for infrastructure and a key issue is how much infrastructure shortages will limit their growth.

- Middle-income countries in Latin America, Europe, the Middle East, and North Africa—some highly indebted—which are implementing important adjustment programs. Here, as indicated, infrastructure deficiencies were probably not decisive in explaining these countries' poor performance in the 1980s, but substantial increases in productivity are needed if infrastructure is going to contribute to the resumption of growth.

- China and India, which comprise almost half of the developing-country population and do not conform to the patterns covering most countries. Factors such as the crucial role of railways, power shortages in India, and the slow development in

telecommunications sets them apart. The two countries are likely to experience important structural changes in infrastructure in the 1990s—particularly a larger role for road transport and a fast expansion of subsectors needed for a more open economy, such as telecommunications, container ports, and electric power.

- Eastern European countries, and those in the former Soviet Union, which have some of the characteristics of China and India and will experience several structural changes in infrastructure like those described for China—but also will have changes in the spatial distribution of production that will greatly modify the level and structure of the demand for infrastructure.

- Most countries in Sub-Saharan Africa, which are undergoing adjustment but still have stagnant economies, which also require drastic increases in infrastructure productivity despite extremely weak institutions.

2.40 Third, the analysis in this chapter also suggests that the interaction among infrastructure subsectors is crucial. An extreme example is that of India, where at one point insufficient railway capacity to carry coal resulted in underuse of thermal power plants which, in turn, affected telecommunications, water supply plants, and water pumps for irrigation. These interactions need to be explored more systematically to better assess investment priorities.

Problems with the Traditional Analysis

2.41 One constant theme that emerges from an extensive review of the literature is that sectoral analyses and actions in the 1980s to improve infrastructure performance were traditional—similar to past efforts. No breakthrough occurred, except perhaps in policy or institutional reforms—which have yet to show significant results. Most of the poor performance has been blamed on technical, financial, or political problems—the political problems being inconsistent policies and inefficient policy implementation. Inadequate maintenance often is raised as a central factor, but so are obsolete equipment and poor construction. Institutional and managerial factors—including lack of skilled staff—are certainly behind many of the reasons discussed, for example, technical indicators such as poor billing and collection, poor maintenance, low wagon turn-around time, power outages, and so on.

2.42 Financial problems derive from having many services provided by enterprises or agencies running a deficit and depending on resource transfers from the central government. Foreign-exchange scarcities indirectly affect services in most countries, even if the agencies are running a surplus. For highway departments, having adequate road-user charges has not assured financial solvency, because central governments usually have not transferred all collected or needed funds to the highway agency. Overregulation and excessive government interference on prices, staffing, investments, and services to be provided continue to be cited to explain poor performance.

2.43 The close interactions among financial, political, and operational issues have been analyzed, but the extent of those linkages is still not clearly understood. For example, public enterprises forced to operate at a deficit and pursuing multiple and contradictory objectives defined

for political or social reasons cannot achieve a reasonable level of operational performance. Under such circumstances, it becomes very difficult to provide the incentives and motivation to staff.

2.44 These undoubtedly are valid reasons for poor performance and need to be addressed, particularly through policy and institutional reform programs. But, as indicated, many of these reasons are too supply-oriented and insufficient to achieve the performance improvements required in the 1990s. A demand orientation is also needed.

Chapter 3

Infrastructure's Linkages with the Rest of the Economy

3.1 Since the mid-1970s, infrastructure's economic role in developing countries has been largely overlooked. Instead, such concerns as investments in directly productive sectors, human resource development, and consistency of economic policies have held center stage. Infrastructure is attracting renewed attention, however, because of the developing economies' poor supply response to adjustment programs. The need to reassess—and reach a consensus on—infrastructure's proper role in development is not a matter of theory, but of fiscal urgency. No matter how much an economy is opened to the private sector, governments will still have to provide a substantial share of infrastructure—and thus plan how to allocate resources. Such decisions often err—partly because of political or social considerations, but also because of an incomplete understanding of infrastructure's interactions with the rest of the economy. Even well-developed project appraisals fail to account for the fiscal implications.

3.2 The Bank, like other development institutions, has paid scant attention to the economic effects of infrastructure. A review of a sample of public expenditure reviews and sectoral studies reveals that the links between infrastructure and the overall economy are only discussed in general terms—and until recently never systematically (Annex 3.1). Although a few sectoral studies deal with country-specific issues—such as the linkages between trade and transport in India—these studies show that the Bank has no systematic opinion about the main operational issues—such as the proportion of public investments that should be devoted to infrastructure. Yet the new challenges—the globalization of trade, increasing market orientation, and efforts to reduce poverty and protect the environment—beg for an understanding of the linkages.

3.3 This chapter briefly considers current knowledge about the linkages between infrastructure and other economic activities—the need for planning, the role of pricing, and infrastructure's ties to poverty and the environment. The intent is only to highlight issues needing research.

Macroeconomic Linkages

3.4 The evidence on macroeconomic linkages is sketchy—largely confined to developed countries, and highly suspect in its results. For example, a study by Aschauer on the United States and other developed countries concludes that the return on investments in infrastructure is about 40 percent, but the analysis has been found to be incorrect (Aschauer 1989). A particularly difficult problem has been trying to determine whether infrastructure investments have promoted growth or whether expansion of the economy has led to greater demand for infrastructure. It is likely that the causality goes both ways, but research has not separated the different effects in a way that provides precise answers. Also, the notion of diminishing returns from infrastructure investments is supported by several studies. Research also suggests that public infrastructure investments first crowd out private investment in the year they are made, but lead to greater private investment in later years.

And the World Development Report 1991 concluded that a distorted policy environment substantially reduced the return on the investments.

3.5 One shortcoming of most of these macroeconomic explorations is that they do not take into account the efficiency with which increases in capacity are used. In this respect they are supply oriented and assume operational performance is adequate and implicitly unchanged in the time covered. In fact, whether an investment in infrastructure capacity achieves its full potential contribution to economic output depends not only on operational performance but also on the demand for the service: if effective demand is lacking or other services are desired, consumption will be less than expected.

3.6 This dearth of knowledge is quite remarkable. The Infrastructure and Urban Development Department is undertaking research to assess the marginal productivity of infrastructure investments in a sample of developing countries. The approach is to collect evidence at the macro and micro levels and explore ways of reaching more meaningful conclusions through a complementary analysis of both levels. The available information hampers cross-country comparisons: data from different countries are often collected using different definitions. Even basic data—such as the proportions of infrastructure sectors in GDP—are hardly credible. For example, in 1987 infrastructure was 16.8 percent of GDP in Bangladesh and 14.1 percent in Morocco, but only 8.1 percent in Brazil or 8.9 percent in India. Most analysis of effects and linkages has been based on secondary—usually aggregated—data. Apparently, systematic primary data on the effects of infrastructure have not been reported anywhere.

3.7 ***Influence on output.*** Infrastructure can influence output through supply and demand. It can affect the *supply* of total output by being a direct input in production; making private capital or labor more productive, or enhancing an area's ability to produce by attracting workers or private capital from other regions. Infrastructure can affect the *demand* for total output by creating income for workers and entrepreneurs through the construction of facilities, crowding in private investment by encouraging it through complementarity, or crowding out private investment when this is replaced by infrastructure investments—and by generating a greater demand for infrastructure services as the economy grows. The supply effects are more long term than the demand effects.

3.8 ***Real, financial, and fiscal dimensions.*** Infrastructure's linkages—real, financial, and fiscal—with the rest of the economy have important policy implications. In addition to the linkages to output, the employment effects and the importance of infrastructure investments and services in the total economy are equally relevant. A similar analysis can be made of financial linkages—for example, the effects of borrowing by public infrastructure enterprises on the availability of credit for private infrastructure. The fiscal linkages include deficits of public enterprises, subsidies, user charges, and cost recovery. In addition, sectors can be substitutes, as between transport and telecommunications, but more often they will be complements, as the links between transport, power, and telecommunications.

3.9 Unfortunately, most evidence about the effects of infrastructure involves individual investments or services. The most readily available data show that Bank-financed infrastructure projects—particularly those in transport—have higher internal rates of return than the Bank's average

(Appendix Table A.3). Although these figures have serious problems of interpretation—sectors use different appraisal methodologies, and *ex-post* evaluations have incomplete streams of benefits—the figures indicate that infrastructure investments might be among the most productive, and suggest a shortage of infrastructure facilities.

3.10 ***Long-term effects.*** The long-term effects of infrastructure may be the most important—for example, effects on land use, the location of economic activities, the pace of urbanization, and the shape and density of cities. Infrastructure could be key in determining whether a developing country becomes, for example, an urban society based on high density and public transport or one with low density and private transport—or, worse, the former for the poor and the latter for the rich. In fact, urbanization with its underlying economies of agglomeration might be one of the main factors explaining economic growth in a number of countries. Once urbanization begins to level off, as in Latin America, growth rates begin to slow. This hypothesis needs to be explored, because conventional wisdom has causality going in the opposite direction.

3.11 A related issue is how the cost functions of different types of infrastructure behave under different assumed densities of economic activities and population. There is no reason to suppose that the cost functions will vary following similar patterns. Telephones will be different from water, which will be different from the various transport modes. Similarly, one would expect different relationships for the sectors among countries, because of varying relative factor prices, among other things. These cost relationships are the building blocks for understanding the long-term effects of infrastructure. Location is one of the key organizing ideas about interactions among different infrastructure elements, an important reason for dealing with infrastructure services as a whole.

3.12 Knowledge about long-term effects varies considerably among sectors. For example, for all the bias on short-term effects, they have been considerably researched for transport—particularly highways—and reasonably well for electric power. The big gap is telecommunications—an odd gap in light of telecommunications' obvious major influence on foreign trade, services, and production more generally, the links with informatics, and the huge unmet demand in most developing countries.

3.13 ***Deterioration of services.*** Another area needing research is the difference in effects between the addition of infrastructure services and the deterioration or suspension of services. Available evidence suggests that the deterioration or suspension might have more effect. (See Chapter 4 for a discussion of the Nigerian experience in this respect.) The topic is especially relevant in light of the continuing difficulties with maintenance. Deteriorating infrastructure is known to cause increased costs for users and suppliers, unreliable services, congestion, private generation of services at much higher costs, and—in extreme cases—a breakdown of economic and other activities. But the pattern and intensity of those effects for each subsector are not known.

3.14 ***Sequencing.*** Little is known about the proper sequencing of infrastructure investments compared with other changes that can affect development, and about the threshold point when infrastructure becomes a real limitation to development. In recent years, a number of countries in Asia have managed to grow fast without their infrastructure growing commensurately. Congestion

has ensued, sometimes dramatically, but the jury is still out on whether inadequate infrastructure was a major barrier to growth. The effects of inadequate infrastructure, and whether countries can withstand considerable shortages and continue growing at high rates, may depend on whether other factors are in place—for example, a dynamic private sector, an open economy, and consistent policies. But if there are no other dynamic factors, adequate infrastructure can act as a central stimulus. For example, the "incubator" theory postulates that the confluence of infrastructure and other services in central urban areas induces the establishment of new small enterprises, which otherwise would not be profitable.

3.15 On the other hand, some developing countries have too much infrastructure at certain sites—which can tie up needed resources. The explanations include speculative investments intended to stimulate development—such as new industrial cities in Egypt—tariffs set too low to ration demand, incorrect decisions on where infrastructure will be needed, and outmigration after infrastructure is built. As indicated, a corollary is the need to know more about the complementarities among sectors—for example, between transport and telecommunications regarding industrial development.

3.16 Another broader way to look at sequencing is from the perspective of countries at different stages of development. A systematic analysis—now unavailable—of how infrastructure needs evolve during development would help with judgments about the adequacy of infrastructure at particular stages.

Pricing and Cost Recovery

3.17 Pricing and cost recovery issues are well-treated elsewhere, particularly regarding roads, the most complex case (Heggie 1991). Here only selected issues directly relevant to the other topics in the paper are highlighted. A key issue is how pricing policies in the different sectors reflect their institutional structures. Other issues are that pricing and cost recovery policies have not taken into account the fiscal effects and the cost of public funds, and the major negative effects of distorted pricing on resource allocation, on operational and managerial standards of infrastructure services, and on the environmental impact of infrastructure.

3.18 ***Pricing and the institutional context.*** Pricing policies reflect the institutional structure of the sectors and subsectors. For infrastructure that is organized in public enterprises—power, telecommunications, railways, and urban water and sanitation—efficient pricing is based on long-run marginal cost. But in sectors organized as government departments—roads, irrigation, and rural water and sanitation—the efficiency price is defined in terms of short-run marginal cost. This pricing divergence is unjustified—reflecting only the institutional differences. The divergence exists because enterprises rely mainly on the direct pricing of their services to recover costs and finance additional capacity—making long-run marginal cost usually significantly higher than short-run marginal costs. By contrast, government departments do not depend on internally generated funds to cover costs—instead using direct budgetary allocations. These differences in treatment create distortions in the public sector—and particularly for competition among different types of transport.

3.19 ***Pricing, cost recovery, and fiscal effects.*** A pervasive problem with infrastructure pricing policies is the neglect in many cases of the budgetary effects of those policies. Because of a strict application of short-run marginal cost principles or of an inability—or unwillingness—to increase prices, governments often have been forced to cover costs by subsidization, writing off debts, lending at preferential rates, or allowing assets or services to deteriorate. However, in recent years the cost of public funds has been as much as twice that of private funds, most governments have limited tax capacity—and extensive government borrowing may no longer be feasible. Thus, an analysis of the fiscal effects of pricing policies must be incorporated in the policies' implementation. Such a framework, being developed for roads—in the forthcoming policy paper—overturns traditional thinking by suggesting that prices be based on the most economically efficient way to recover total costs.

3.20 The negative effects of setting prices too high or too low are beginning to be analyzed more systematically. Charging too little and/or under-allocating funds has led to a vicious cycle of inefficient operations, unreliable service, and deterioration of capital assets. All these developments imply poor service, which in turn has adversely affected consumers' willingness to pay and thus the ability of the supplying institutions to cover costs. In irrigation, for example, the proportion of costs recovered has been between 15 and 45 percent. Institutional issues further exacerbate the negative effects—as in cases where charges are not collected by the suppliers and need to be allocated through a political process. Allowing prices that are too high in the current climate of deregulation could induce the entry of private sector operators who can take the best clients away from the public suppliers. The existence of considerable cross-subsidization, as happens extensively in infrastructure, exposes public operators to selective private competition which will prevent the continuation of the cross-subsidies—usually politically imposed—and greatly deteriorate the suppliers' financial situation. The problem is that differentiated prices are justified on economic efficiency grounds: "Ramsey" pricing—charging higher prices to users with low elasticity of demand and lower prices to users with higher elasticities—minimizes the welfare loss from charging more than marginal costs.

3.21 Entry of alternative suppliers can hurt economic efficiency or cost recovery by undermining the economies of scale of the public-sector operators—thus increasing operating costs and triggering a vicious cycle. This situation may be exacerbated by overconsumption and possible congestion where the prices are lower.

Effects on Poverty

3.22 The effects on poverty need to be explored further. Infrastructure problems can affect the poor disproportionately—such as forcing the poor more often to obtain more-expensive or less-safe alternatives (Whittington and others 1990). Higher-income groups usually manage to capture the best services available. The difference in the quantity and quality of infrastructure services between the rich and poor sections of cities is the most glaring illustration. The negative environmental effects of inadequate infrastructure—such as air and water pollution—are most evident in densely populated inner cities, where the poor are concentrated. Inadequate services also affect the poor's labor productivity and access to employment—for example, by harming their health. Inadequate access to services—such as transport—also can reduce the time available to the poor to

engage in income-earning or domestic activities. Activities that have a high potential to generate employment for the poor—small enterprises—are particularly hurt by infrastructure deficiencies.

3.23 Generally, approaches to infrastructure services need to be developed that will most affect poverty reduction. And more knowledge is needed about the effects of infrastructure at the household level. Programs to enhance the poor's access to infrastructure through subsidies have proved generally unsustainable because they are extremely difficult to target.

Effects on the Environment

3.24 Evidence of serious and worsening environmental degradation in developing countries and recognition by donors and countries of the complementary role that the environment can play in development have raised questions about the linkages between infrastructure and the environment. It is important, however, that scrutiny of these linkages not be based on assumptions drawn only from the experience of developed countries, where expansions in infrastructure are usually seen as entailing some environmental sacrifice. The World Development Report 1992 has focused on environmental issues and proposes a comprehensive action program for developing countries (World Bank 1992). Here, only a few issues particularly relevant to infrastructure are highlighted.

3.25 The environmental problems related to infrastructure in developing countries are a strange mix. On the one hand, rudimentary cooking and home heating appliances—in poorly ventilated areas using dirty fuels—may expose many people to harmful levels of indoor air pollution. Millions more must cope with a high incidence of waterborne and foodborne disease. Both problems were more or less eliminated in developed countries a century ago. On the other hand, as economies develop, countries are increasingly subject to the ills of industrialization—such as hazardous waste dumps and urban photochemical smog. As a general rule, infrastructure development helps correct the problems in the first category while exacerbating those in the second.

3.26 Thus, although the negative effects of infrastructure expansion should be considered, the improved delivery of infrastructure services can also help maintain and improve environmental quality. Indeed, the benefits to commerce, tourism, and work force productivity that may be associated with infrastructure make a compelling economic case for its improvement, even if its direct externalities are ignored.

3.27 It is still not too late for most developing countries to prevent the kind of environmental damage experienced by developed countries. The environmental effects of many infrastructure changes depend on the details of their use—for example, where a highway is built or the type of fuel used for power production. Issues to be studied include, for example, the linkages between long-term effects, urban infrastructure investments, and the shape and density of large urban areas.

3.28 ***Pricing.*** Pricing that is too high or too low can indirectly harm the environment. Excessive charges for services that help protect the environment—such as sanitation—may lead consumers to find alternative, less-safe solutions. Thus, local governments spend 30 to 50 percent of their operating budgets on the collection of solid wastes (World Bank 1989c). Most problems,

though, result from failure to charge users the marginal cost of a service. Subsidies can lead to excessive consumption, inefficient production, and insufficient funds for proper maintenance or expansion. Poor maintenance may cause sewer backups, for example. Of 200 waste treatment plans in Mexico, 80 percent have been unusable because of poor maintenance (Bartone 1989a). Or, in Lima, Peru, less than 60 percent of the refuse collection fleet is available at any one time—which causes "the almost universal transformation of planned sanitary landfills into open dumps" (Bartone 1989).

3.29 Subsidies also may have environmental consequences by favoring one mode—of transport or power production, for example—over another. Low taxes on heavy vehicles may encourage their use at the expense of railways which may be less polluting. Cheaper prices for coal—compared with, say, natural gas—may increase air pollution. Proposals to include externalities in pricing—for electricity, for example—range from economic incentives, such as emission fees and tradable permits, to laws requiring that a certain percentage of emissions from a vehicle or power plant be treated. Emissions from output are relatively larger in developing countries, because the quality of fuel burned is lower, the technology is more primitive, and the operating personnel are unlikely to be well-trained. For instance, particulate emissions from power plants in China are very high because, in part, unwashed and unsized coal with an ash content averaging 27 percent is burned, as opposed to the ash content of 11 percent burned in the United States. Although per-capita electricity consumption is still low, the high income-elasticity for electric power implies that this sector will grow rapidly with development.

3.30 ***Infrastructure deficiencies.*** Many of the negative environmental consequences of infrastructure in developing countries are directly correlated with operational deficiencies—particularly limited access, unreliable equipment, and distribution losses. Limited access and unreliable equipment produce some of the same problems associated with inadequate pricing. In addition, unreliable equipment may increase pollution. Start-up of steam-electric boilers when maintenance is poor causes a large emissions "pulse" of hydrocarbons and flyash. Or, backup plants used to make up for power shortages—as in Nigeria—are likely to be more polluting. Reducing power distribution losses—caused by line losses, for example—can limit the need to expand capacity.

The Need for Planning

3.31 The widespread disenchantment with planning and with the public sector—and the emphasis on the private sector—have led to the virtual abandonment of infrastructure planning. Some form of planning is needed, however, because of the public sector's continuing important role in providing infrastructure. Whether governments are laissez faire or interventionist, they still need to decide how to allocate public sector investments to infrastructure. In addition, environmental, political, and social considerations specific to each country require an overall perspective. Governments thus need information about the interactions between infrastructure services and key macroeconomic and sectoral variables, the costs and benefits of non-economic objectives pursued through infrastructure services, the effects of current infrastructure policies on services, the expected rates of return on current public sector investments, and about other economic objectives—such as

exports or regional development—that may be influenced by infrastructure or influence demand for infrastructure.

3.32 As infrastructure becomes privatized, and markets begin to function, the distinction between planning and sectoral policy management may be increasingly blurred. As the focus changes to policy management, the first priority should be to identify the main ingredients needed for that task—a conceptual framework, information and monitoring requirements, supporting economic and social analysis, and institutional capacity. However, although a better understanding of these issues can greatly improve policy management and investment decisions, cost-benefit analysis will need to remain central to investment decisionmaking, but improved through the explicit inclusion of externalities (e.g., the environment) and distributional and fiscal impacts. Combining macro- and microanalysis to improve the quality of decisions will continue to be an art.

Infrastructure Sector Adjustment Loans/Credits

OPERATION	INFRASTRUCTURE SECTOR/S INVOLVED	LOAN/ CREDIT IN $ MILLION	INFORMATION AVAILABLE ON SUPPLY, CONDITION, OPERATING AND FINANCIAL PERFORMANCE.	OBJECTIVES OF THE OPERATION
1. Water Supply and Sanitation Sector Adjustment program, Côte d'Ivoire, (Report No. P-5089-IVC, June 1990)	Water Supply & Sanitation	80	72% in urban & 80% in rural areas have access; good operating performance in the urban areas, inadequate maintenance in the rural areas; cost recovery poor in rural areas; net internal cash generation financed only 7% of capital investments.	Privatization, efficiency pricing, and reduction of dependence on public budget support. Action includes: rationalization of tariffs, transfer O&M to users in rural areas, financial restructuring and regulatory reforms.
2. Public Enterprise Sector Adjustment Program, Mauritania.(Report No. P-5293-MAU, May 1990)	Power, Water, Communications. (Port Sector marginally involved.)	40	Water and power utility performance improving as a result of an earlier technical assistance project supporting reforms. Port sector financial performance not satisfactory in 1989; post & telecommunications' earlier reform measures modest, and progressing very slowly.	To extend and deepen ongoing reform efforts, facilitate privatization, financial restructuring, and reduce state's role.
3. Road Transport and Telecommunications Sector Adjustment *BProject, Mexico.(Report No. P-5254-ME, May 1990)	Road, Telecommunications.	380	Restrictive regulatory environment for road transport, inefficient operations and poor multimodal service; overall road costs are recovered, but there are cross subsidies between automobiles and trucks.Trucks pay only 50% of road costs, even after increasing diesel prices in Dec. 1989 (increased 15% before); rail tariffs below cost; about 20% of Mexico's federal highway network is badly deteriorated because of inadequate maintenance over several years. Telecommunications system is a major constraint to economic growth: long waiting for connections, unreliable, and heavily congested service.	Private sector development: deregulation in the trucking sector, privatization and regulatory reform in the telecommunications sector. Pricing and taxation distortions in the two sectors are being eliminated. Measures to improve highway safety and to monitor compliance of pollution standards.
4. Energy Sector Adjustment Program, Cote d'Ivoire (Report No. P-5165-RCI, December 1989)	Power	100	Suboptimal generation, underdeveloped distribution. Inefficient public enterprises: high electricity prices. Operating performance deteriorated since 1982-maintenance inadequate; transmission has been affected by frequent interruptions; distribution has suffered from equipment damages—weak financial management-overly ambitious rural electrification program contributing to poor financial performance.	Implementation of comprehensive medium and long term policy framework for the energy sector. Improve investment planning, increase operational efficiency and strengthening financial management of the electric utility, including introduction of more efficient flexible pricing mechanisms.
5. Transport Sector Adjustment/Investment Project, Chad (Report No. P-4977-CD, March 1989)	Transport	60	Highway network has deteriorated after years of inadequate maintenance; monopoly-induced inefficiencies in trucking and high transport costs.	To reduce cost and the price of transport is the principal objective. The credit would support: promotion of competition and a greater role for private sector in road construction industry, improving resource mobilization and allocation in the sector, abolition of existing monopoly and administered tariffs, road rehabilitation, adequate maintenance.

6. Energy Sector Adjustment Credit, Bangladesh . (Report No. P-4549-BD, March 1989).	Power	175	Transmission system development does not match generating capacity. Distribution losses high, system needs renovation. Unreliable and poor quality of supply, very high system losses (33-43% of generation),low manpower productivity, high accounts receivables, tariffs below costs; internal funds financed 10% of investments by the electricity utility in 1980-88. Support Govt.'s reform program: pricing and cost recovery; tariff restructuring and minimization of subsidies; balanced investment in transmission, distribution, and generation; improvement in institutional performance.	
7. Public Enterprise Sector Adjustment Loan, Mali (Report No. P-4734-MLI, June 1988)	Power and Water	40	Management and financial difficulties, because of institutional structure in the power and water utility.	Improve public enterprise performance, reduce dependence on public finances. Action program includes: organizational restructuring of EPM (electricity and water company), and OPT (posts and telecommunications company) (e.g., creation of the new posts and telecommunications companies).
8. Power Sector Adjustment Loan, Colombia (Report No. P-4676-CO, November 1987)	Power	300	Access to 58%; 95% in urban areas; supply well in excess of demand; inadequate maintenance of distribution facilities, resulting in their deterioration, and overloading; high system losses; serious financial difficulties (because of high debt service requirements, heavy arrears, esp. from the public sector, and high losses, and lack of regulatory framework and inadequate supervision); Exceptions are EPM (Empresas Publicas de Medellin) and, CVC (Corporacion de Autonoma Regional del Cauca). Tariff structures are distorted: residential tariffs are low relative to LRMC; subsidized consumption blocks are large; industrial tariffs in Bogota are high.	Improve efficiency of power generation, transmission, and distribution; rationalize investments, bring electricity pricing in line with long run marginal costs, finance large share of investment from internal cash generation, improve the regulatory framework and utility management, and financial restructuring of the sector.
9. Energy Sector Adjustment Loan , Turkey (Report No. P-4513-TU, June 1987)	Power	325	High operating costs (attributed to absence of systematic maintenance, and low levels of utilization); tariffs increased, still below LRMC.	Hybrid-Support Govt.'s reform program (increase private sector participation, greater financial autonomy, and focus on high-priority investments), and provide part finance to investments in energy sector.
10. Public Enterprise Sector Adjustment Loan, Niger (Report No. P-4522-NIR, June 1987)	Power, Telecommunications and Water	80		Policy reforms: tariff setting for water, power, and telecommunications to cover operating costs, debt service, and a reasonable share toward new investment costs; private sector development; and legal and institutional reform (accountability, supervision, financial autonomy etc.)
11. Public Enterprise Sector Adjustment Loan, Jamaica (Report No. P-4579-JM, May 1987)	Transport, Power, Water, and Telecommunications.	20	Operating losses in the railway sector, requiring central govt. budgetary support; port authority has generated operating surpluses since 1980; Power service quality and financial performance improving; The National Water Commission suffers from management problems, shortage of funds (heavy arrears from govt. agencies, failure of tariffs to keep pace with inflation); Steady improvement in the quality, reliability, and accessibility of telecommunicationsin in recent years; however, still-extensive delays in rectification of technical faults.	Reduction in the size of public sector; elimination of inter-governmental arrears; improved operating balances of public enterprises targeted; and monitoring and control of public enterprises. Action programs concerning infrastructure include: privatization and/or liquidation of loss-generating railway services; periodic tariff adjustments in the water sector to cover cost increases, and elimination of arrears; and privatization of the telecommunications system.

Source: World Bank Appraisal documents.

Chapter 4

The Reliability of Infrastructure Services

4.1 The central theme of this paper is the need for enhancing productivity of infrastructure through a stronger demand/client orientation. One key ingredient is an increased focus on the reliability of services. Reliability is important for two reasons. First, since reliability is essentially in the eyes of the user or client, it helps to induce a more demand—client—oriented perspective on traditional issues of operational performance. Since operations always have been, by definition, supply-oriented—mostly in the hands of engineers and accountants—a different focus linking demand issues more closely with operations seems a more effective approach for increasing productivity. Second, reliability is an increasingly important ingredient of infrastructure quality. In the early stages of development—especially in growth strategies oriented toward self sufficiency in the last four decades—the first priority has been access to services. But access is no longer enough. The increasing proportion of international trade in most developing economies, the globalization of the world economy, the accelerating pace of industrialization resulting in more high-value-added products, and the major changes in manufacturing and logistic technologies—for example, just-in-time inventories—increasingly require services that are reliable. For some activities, such as an artisan shop or even irrigation, frequent electricity cuts are expensive. For high-technology computer work or the handling of frozen materials, however, frequent interruptions could bring ruin. A country cannot begin to participate in the globalization of financial markets without good telecommunications. The essence of just-in-time inventories is absolute reliability in the distribution and communications systems.

4.2 The concept of reliability is important not only for relatively high-technology activities, however. If developing economies become truly integrated in the international economy they will not be able to keep a dual economy—one integrated and another isolated—for long. Even relatively lower-technology activities, such as the export of perishables, have required a high level of infrastructure reliability. Also, there is evidence that unreliable services affect the poor much more negatively. A key ingredient of successful poverty reduction strategies will be reliable infrastructure services.

4.3 Of course, the importance of reliability varies significantly among activities and subsectors—and countries. At one extreme, for developing economies that are pursuing an export-led growth strategy—such as Chile, Korea, Malaysia, and Thailand—the reliability of infrastructure is already a serious issue that would apply to most aspects of their economies. At the other extreme, in still-closed and undeveloped economies in Sub-Saharan Africa, the issue of accessibility of services is still central. The paradox, however, is that the longer countries delay emphasizing quality or reliability, the harder it will be to accelerate growth—particularly to participate fully in international trade. And although reliability is more important, for example, for the transport and telecommunications subsectors in foreign trade, it can be a useful focus in all sectors.

4.4 The importance of the concept of reliability has emerged from the need, due to the developments described above, to focus on the quality of infrastructure services rather than only on the quantity or accessibility of services. Not only that, but for a number of economic activities very specific levels of quality are required. It is no longer possible to think of infrastructure services as having one, uniform level of quality, as is usually the case in discussions about the role of infrastructure. The notion of "service" needs to be disaggregated to be able to explore those levels of quality required by different types of activities. After all, the central objective is to provide the quality of services in the most effective way. In this context, reliability is just one approach that promises to be operationally useful.

Definition

4.5 For users, reliability means that a service has a high probability of being available in the quantity, quality, and at the time required. This concept of reliability can be directly linked to a specific use.7/ Users indirectly decide about production because of the level of quality—reliability—of infrastructure services they expect. Substantial changes in that reliability will induce changes in the users' behavior. For example, a brokerage firm might expect almost 100 percent completed connections in telephone service; a reduction to 70 percent will greatly disrupt the operation. Or a farmer might count on weekly truck transport; if the truck does not appear in a key period, the farm's output might be lost. In most cases—and especially in developing countries—unreliable service is the result not only of technical aspects but also of managerial and financial failures.

4.6 Reliability is measured in different ways for different infrastructure services. For electricity, it is measured by the number, length, and time of power outages, and by changes in voltage and frequency levels; for freight transport, by the meeting of delivery schedules and by loss or damage to goods being transported; for passenger transport, by delays in travel time; for telecommunications, by delays in dial tone, uncompleted telephone connections, and interferences with the sound; and for water supply, by the timely delivery of promised amounts of water and its quality for drinking, irrigation, or other uses.

Demand for Reliability

4.7 The demand for service reliability varies considerably among economic activities, depending on the level of technical sophistication. Thus, the importance of reliability varies at different stages of economic development. At one extreme, there is little demand, or expectation, for reliability in subsistence agriculture. The demand begins to appear in the early stages of commercial agriculture or industrial production. In general, manufacturing requires relatively more reliable power, transport, or communications. A shift from manufacturing to a service economy requires even better communications facilities. At the other extreme are the activities—such as exports of perishables or modern technologies using sophisticated computer work—that are

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7/ The definition might also be extended to include price reliability, but that dimension has been left out of this analysis.

impossible without reliable power, water, transport, and communications. Although the demand for reliability will vary significantly among countries, in all countries, foreign trade—particularly exports—will typically demand higher reliability.

4.8 Suppliers of infrastructure face a variety of demands for reliability. One distinction is in demands for infrastructure as an intermediate input, for which the effects of unreliability could be serious—for example in terms of lost production, idle capital or labor, or spoilage. Demand could come also for infrastructure as a final or consumer good, in which case unreliability is more in the form of an inconvenience or lost time, although many other negative effects could ensue, on health or time available for directly productive activities. Thus, suppliers must adapt their services to those varying demands for reliability. For example, in transport, perishable goods are sensitive to time delays as well as damage during processing and handling. Precision goods demand smoothness of processing to avoid damage and might not survive transport over roads or railway tracks that are in poor condition. In water supply, the demands for water quality differ for households, industrial users, fire departments, or road cleaners. Similar examples can be given for the other types of infrastructure. Thus, the nature of the demand makes it difficult to evaluate the reliability of a whole infrastructure network, since such networks are needed for competing uses, each of which has a different reliability requirement. This is why a clear user's perspective is operationally so important.

4.9 The effects and perceptions of reliability may vary according to time and location. The reliability of infrastructure components may vary from link to link—as in a system supporting an international trade chain (Fig. 4.1). For example, in India the current objective is to improve competitive prices and delivery schedules—and thus export performance. This objective differs from past goals to consolidate the economy and achieve self-sufficiency through import substitution. The past objectives depended on infrastructure differently than they do now. Systems whose reliability may have been adequate for past objectives do not live up to current demands.

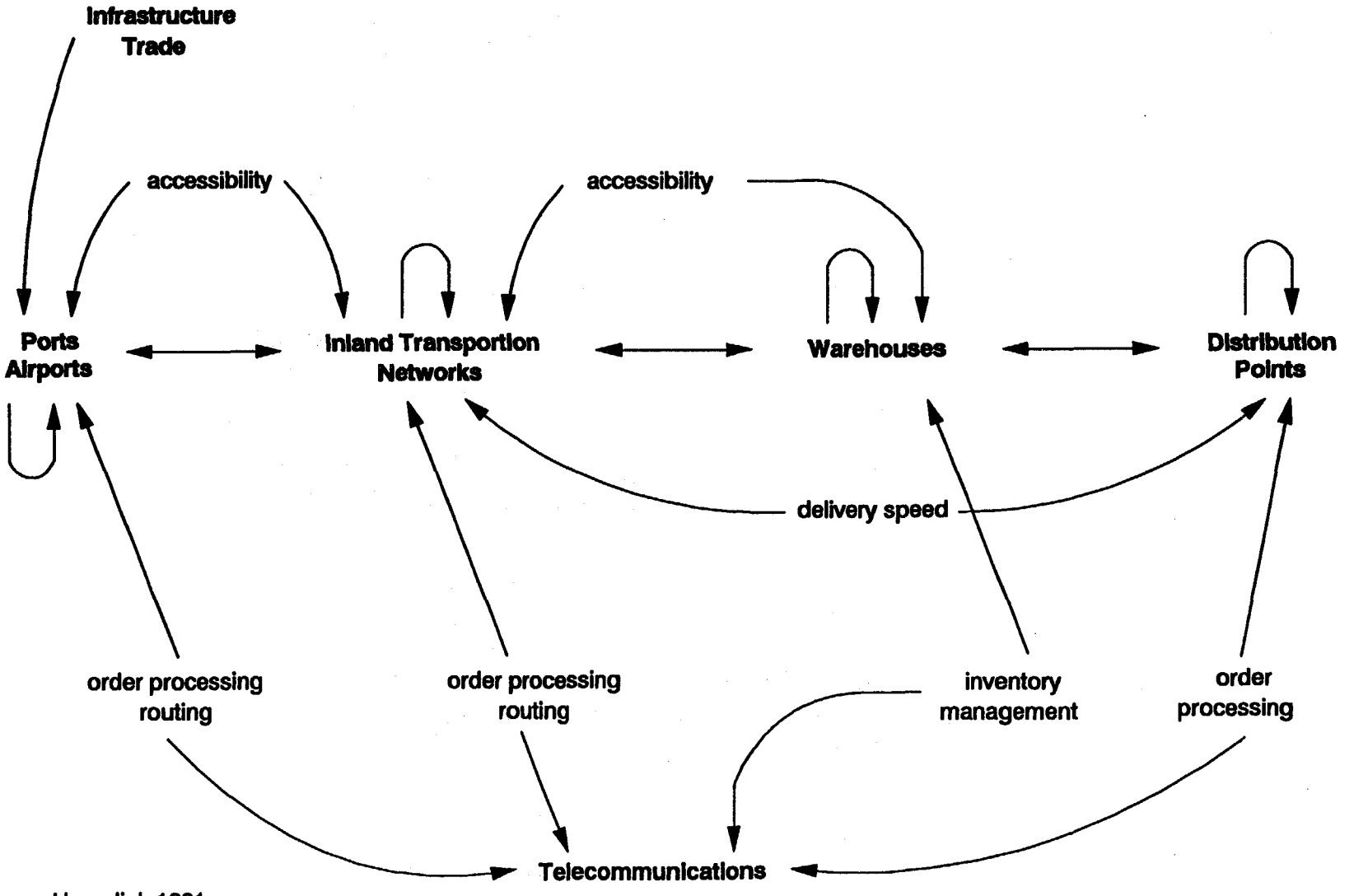
Effects of Unreliability

4.10 Infrastructure reliability is generally poor in developing countries, although it differs widely among countries and sectors. Many of the nine countries analyzed in depth for this study suffer from frequent power outages and voltage drops. In northern India, electricity shortages in 1989 led to power rationing for industry, agriculture, and domestic use; the grid collapsed nine times in six months, interrupting about one-third of the system and requiring three to five hours each time for restoration. Voltage drops of 25 percent are common, often causing rural water pumps to burn out. Failure rates of local telephone calls ranged from 8 percent in Bombay to 43 percent in Calcutta, compared with 2 to 3 percent for a well-operated exchange in a developed country.

4.11 Inadequate road maintenance also can make roads impassable, as in Ghana in the early 1980s, when access to interior areas was curtailed. In Nigeria the rural road network had deteriorated so badly that produce often had to be moved by head-loading, which costs about forty times more than transport on well-maintained roads. Poor rural roads also made water from tank trucks more costly and unreliable. Water is periodically rationed and—because of equipment failures —water treatment works are not reliable, threatening water quality. In India, 20 to 25 percent of

Figure 4.1

International Trade Cycle



Source: Humplick 1991

rural water supply schemes are out of operation at any time. One cause of unreliable rural water is the fluctuating electricity supply. An unreliable water supply for many irrigation systems contributes to farmers' reluctance to maintain irrigation structures and pay for water.

4.12 ***Infrastructure unreliability in Nigeria.*** Lee and Anas have done the most thorough study of the effects of infrastructure unreliability, focusing on Nigeria (1990). The investigation was intended to detail the effects on manufacturing firms of well-documented failures in infrastructure services—electric power, water, urban transport, and telecommunications. Some of those deficiencies were significant in Nigeria. For example, in 1988, more than two-thirds of the manufacturing establishments suffered more than five power outages per week and 17 percent experienced more than ten—with almost 20 percent of them having to shut down operations during those power failures.

4.13 This research shows that large and small firms are affected differently. Large firms spend significant resources investing in their own facilities and services but small firms are more seriously affected by infrastructure deficiencies. Because of the lumpiness of the investments required and the high operating costs, smaller enterprises can rarely afford to get their own standby generators, boreholes, radio transmitters, or messenger motorcycles. Since many new jobs in urban areas come from new small enterprises—generally 60 to 80 percent of new jobs in major cities—the negative effect of infrastructure deficiencies is substantial. And the higher costs to Nigerian firms affect their ability to compete internationally.

4.14 Although all 179 firms studied are connected to the power grid, every firm with more than 20 employees has its own standby generator—and has invested, on average, $130,000 on power facilities. But, only one-third of the small firms—fewer than 20 employees—can generate their own power. Similar variation by size of firm is found in the private provision of water supply. No sampled small enterprise has its own water supply; about 14 percent of the firms with 20 to 50 employees have their own supply; and two-thirds to three-fourths of medium-to-large enterprises—with 100 or more employees—have private wells. No small firm has a private communications system, such as a messenger motorcycle or radio transmitter, but because public telecommunications services are inadequate, 70 to 90 percent of the firms with 500 employees or more have their own radio transmitters.

4.15 The capital value of these private infrastructure facilities averages 25 percent of the total value of machinery and equipment for firms having fewer than fifty employees and about 10 percent for firms having fifty or more. The percentage of total capital costs varies according to the type of service. The average capital cost for electricity generation is almost four times larger than the share of capital for wells and treatment facilities. The average cost of generating electric power privately was about nine times higher than the average cost in advanced developing and developed countries. This illustrates the firms' willingness to pay for reliable services. The sample firms, as a whole, used only 25 percent of their privately installed generating capacity. The presence of these largely idle reserves of generating capacity contributes to a high average fixed cost.

4.16 ***Costs.*** The costs of unreliability can accrue not only to users but also to suppliers, who can lose their original investment if they don't act to improve reliability; operators facing future

difficulties in managing demand, such as dealing with congested services; and non-users as a result of negative effects such as pollution, noise, environmental degradation, and lower land values. The types of costs resulting from unreliability vary, depending on usage. For example, in power supply each of the users has a different cost, and there are well-accepted approaches for calculating them (Munasinghe 1979; Lee and Anas 1990). For other forms infrastructure, such as transport, water supply, and waste disposal, there is not one well-accepted approach. An exception is railways, where there are well-documented—although partial—approaches (Martland 1974).

4.17 Also, there are direct and indirect costs of the results of unreliable service, such as power outages. The direct costs occur during an outage and the indirect costs arise if users adapt their activities to become less susceptible to outages—such as paying for other energy sources. Industrial outage costs include damaged materials and lost production, minus any recovery during regular working hours or on overtime. Changes in voltage or frequency can damage electric motors. Commercial users incur losses in sales and services from outages if computers and other office equipment cannot be used, when there are no lights or elevators, when cash registers or gasoline pumps stop working, or when refrigeration stops in stores, restaurants, and hotels. The costs of power outages depend not only on their length and frequency but also on such factors as the time of day or the day of the week and whether the outage was forewarned.

4.18 ***Effect on cost recovery.*** The potential for cost recovery seems to be directly linked to service reliability. Studies have shown that unreliability contributes substantially to users' unwillingness to pay, even when they can afford to do so. Farmers are unwilling to pay water charges not only because of a long tradition that water should be free, but also because the supply of irrigation water is frequently erratic and unavailable when it is most needed. One study found that households in a large Nigerian city—Onitsha—were paying private water vendors more than twice the operation and maintenance costs of the piped public distribution system because the quality and reliability of the private service was better (Whittington and others 1989). Another study in Nigeria found that "households do not trust the government to provide a reliable public water supply" and cited that as a key reason for the low willingness to pay water charges (Whittington and others 1990, para. 106). Anecdotal evidence suggests that unreliability is also important to cost recovery in electric power, telecommunications, and water supply, thus contributing to the pervasive financial weakness of public agencies.

4.19 ***Distributional effects.*** Available evidence indicates that the distributional effects of unreliability are extremely regressive. First, the Nigerian study shows that small firms have much less possibility of generating their own supplies—or protecting themselves from unreliable infrastructure. Even when such firms do attempt to provide their own infrastructure, economies of scale make the costs higher for the smaller firms. Second, the cost paid by the poor for reliable supplies is often several times the public price. In Nigeria, in some instances, the poor pay nine or ten times the price of public water service or—worse—they have to devote much their time to obtaining water. In Istanbul, recurrent costs assumed by households to cope with unreliable infrastructure range from 1 to 5 percent of annual income, with the poorest households facing the higher proportion. And, in general, women bear much of the burden of these extra costs (Box 4.1). Third, as indicated the rich often manage—as Samuel Paul (1991) puts it—to "capture" the few good services that are available. Developing countries are full of examples of this phenomenon—from the

perfectly maintained road and telephone line to a politician's farm, to better services to the richest sections of a city, to preference given to particular shipments by road or rail. The poor have little voice and are not in a position to pressure suppliers to improve their reliability.

Box 4.1
Women and the Reliability of Infrastructure Services

Women in developing countries shoulder a heavy burden to compensate for inadequate infrastructure in urban and rural settlements. When safe water is not available, women walk long distances bringing it home. When transport services are weak or expensive, they headload agricultural produce to market for sale. When roads do not exist, women undertake multiple trips between their homestead and farm carrying inputs and implements. Women often spend three to four times the hours men spend on transport and carry loads three to four times the average weight carried by men (Barwell and others 1987). In Ghana, women spend 977 hours per year transporting 46.6 ton-kilometers; respective figures for men are 346 and 12.1 (Howe 1987).

Among the poor, household reliance on women's remunerated and unremunerated labor is high. When possible, women combine household and nonhousehold work. Studies show that women typically work 25 percent longer hours than men—up to fifteen hours more a week in rural India and twelve hours more in rural Nepal (UNDP 1990). They simultaneously undertake infrastructure services, domestic tasks, and income-generating activities. The flexibility in the simultaneous execution of tasks typically undertaken by women is reduced when they are required to work fixed hours in the formal or the informal sectors.

Inadequate and unreliable infrastructure services make women's work take longer. Many poor women in Istanbul have to leave home two hours before the start of their work, waiting for buses and suffering through heavy traffic. Many spend sixty to eighty hours a week to maintain their jobs; some get discouraged and drop out of work (Kudat, direct communication). The unreliability in the supply of infrastructure services—including transport, energy, and water—increases the incompatibility between the household work and income-generating activities. Poor women have few mechanisms through which they can reduce such incompatibility. Those women on whom households heavily depend for income sacrifice the quality of care they provide to their family; those who can afford to rely on the income of other family members may be forced to withdraw from the labor force and sacrifice quality of life.

A recent study in Chittagong, Bangladesh, shed light on the broad range of strategies women use to deal with the irregularity of water supply services (Kudat and Fon 1991). The poorest, who lack access to safe water dramatically reduce their consumption levels. Those with access to highly polluted sources use them for bathing, dishwashing, and laundry. Women whose husbands work where public taps are located rely on the husbands to transport drinking water. Finally, women who earn a higher income, exit from the slums to residential compounds where they can enjoy access to multiple sources of safe water and thus reduce their dependency on the piped water system, which is unreliable. In middle- and higher-income neighborhoods a large percentage of families with connections to the piped water system also have handpumps and wells. Elsewhere in India and Pakistan, a similar situation is observed. In rural Punjab, more than 90 percent of households with connections had an alternative source (Altaf and others 1990). In rural Kerala, 95 percent of households with connections also had an alternative source (Ramasubban and Singh 1989.)

Prepared by Ayse Kudat

4.20 In general, the effect of unreliable infrastructure on the poor is more glaring at the household level, where unreliability can pose significant health hazards. An extreme example is water supply in Istanbul, where no household can drink tap water and households thus have to switch

to alternative sources, reduce consumption, install redundant capacity, or have their own treatment facilities.

The Growing Importance of Reliability

4.21 The globalization of the world economy is a momentous development that will have important positive effects on developing countries (Peters 1991 and 1992). Just exposing an economy to foreign competition imposes stricter demands on the quality and reliability of most activities, including infrastructure services, than demands prevailing in a closed economy. If a country also wants to join the more advanced production processes, such as just-in-time inventories, the demands are even stronger. But stricter demands apply to all activities in international trade, not only the advanced ones, such as the productions of automobile or electronics parts. For example, the strict inventory controls kept by retailers in developed countries impose stricter delivery schedules for imports of artisan work. Initially, the pressure exercised by international competition will have a salutary effect only on tradables but, over time, such positive effects will be spread throughout the economy, especially if the export and import base is broad. The analysis below also illustrates how institutional weaknesses affect the provision of infrastructure services and how administrative barriers are primarily responsible for delays in distribution systems.

4.22 The world economy is facing a new kind of industrial competition (Alavi 1990). New international rivals have emerged with advantages in costs, productivity, or government support. New products or processes have created unusual possibilities in marketing and production. Rapidly changing technology in production and communications has transformed the competitive dynamics of the world economy. The adaptability of supply to day-to-day variations in demand is a central characteristic of the new world competitive environment. Although in this new environment price competition remains important, quality, delivery time, marketing, services and the ability to adapt rapidly to changes in demand are becoming crucial to capturing and maintaining markets. The globalization of world markets and new production processes—accelerating in the 1990s—will require major improvements in infrastructure quality if developing countries are to participate successfully. These improvements are important because more than 80 percent of exports from developing countries go to developed ones. Alavi's study regards physical infrastructure as "the backbone of competitiveness" and finds that "a sophisticated physical infrastructure—roads, rail, air, and marine transport, telecommunications, power, and so on—is a precondition for productivity growth and successful international competition" (Alavi, para 4.32).

4.23 The increasing globalization of markets permits producers to seek cost advantages for supplies and other inputs worldwide. At the same time, consumer preferences in many markets are changing rapidly as information about new products spreads quickly and increasing incomes make consumers more selective but also more capricious. These changes require quick responses in supplies, production, and marketing. Flexibility and prompt global delivery frequently become as—sometimes more—important as cost and quality. An example is a textile company in Taiwan which is a key supplier of finished garments to a buyer in Germany (Box 4.2). Fashion designs are handled in Taiwan, but tailoring takes place at an offshore manufacturing base in Thailand. The factory in Thailand imports textiles from a weaver in India, cotton from the United States, and synthetic yarn from Indonesia. The final product is shipped from Thailand to Germany. In all this,

the supplier has to be very responsive to the buyer's strategy of reacting quickly to frequent changes in fashion.

Box 4.2
Global Market Connections:
Developing Countries are Getting Involved

Textile Trade: Great Future Textiles Ltd. of Taipei is a vertically integrated textile and garment manufacturer and exporter. The company is a key supplier of finished garments to Modern Fashions in Duesseldorf (Germany). While fashion designs are handled in the Taipei headquarters, tailoring takes place in a recently established offshore manufacturing base in Thonburi, just north of Bangkok (Thailand). The new factory imports high-quality designer textiles from a weaver in Rajastan (India) and cotton from the Texas (the United States). Synthetic yarn is supplied from a chemical industry complex in Java (Indonesia). The final products are air-shipped from Bangkok to Duesseldorf. In all this, Great Future has to be very responsive to Modern Fashion's quick-response strategy.

Plastics Trade: Infantland Stores Inc. of Cincinnati (United States) purchases large amounts of plastic toys from Fortune 21 Ltd. in Hong Kong. Fortune produces these toys in Jiangmen (China) under a joint venture arrangement with a local manufacturer. Fortune buys plastic resin from Downstream Petroleum Exports in Johore (Malaysia) which is shipped through Singapore and Hong Kong to the Jiangmen plant. Infantland buys Fortune's plastic toys FOB ex Jiangmen and arranges for transport through Hong Kong and Long Beach to its home base in Ohio. All transactions are done on a just-in-time basis.

Food Trade: Siam Mills Co. Ltd. is a rice processing enterprise in up-country Thailand that has been successful in expanding its business in less than ten years from supplying a limited regional market segment to being a principal supplier of the North American market. Key to this success was Siam Mill's strategy to assume full responsibility for order processing and inventory positioning on behalf of its customers, a few large supermarket chains in the United States Siam Mills packs rice ready for retail shelves in accordance with the special requirements of each chain and consolidates shipments to regional warehouses for distribution in each state. The benefit for the U.S. customers was elimination of labor-intensive—and therefore costly—packing and warehousing operations.

Steel Trade: An interesting example of cooperation in the processing of iron ore are the relations that Companhia Vale do Rio Doce (CVRD) in Brazil maintains with other firms within the country and in its main external markets. CVRD, together with Kawasaki (Japan) and private enterprises in the United States bought a steel processing plant in California which is supplied with steel plates produced in Brazil. This cooperation was expanded to include a conglomerate in Mexico which imports mineral ore from Brazil for processing into steel plates which are then supplied to the California-based plant. Because this plant is the key provider of steel products to several car and equipment manufacturers on the West Coast, most of whom have adopted just-in-time production arrangements, the supply lines for ore and steel plates have to be well-coordinated to ensure timely and reliable deliveries.

Source: Peters 1992.

4.24 The globalization of markets has been accompanied by new production processes that rely on minimizing inventories by using the just-in-time inventory system. Just-in-time systems force

closer relationships between buyers and sellers because buyers expect perfect quality and absolutely reliable delivery. An example is a steel processing plant in California owned jointly by a Brazilian, a Japanese, and an American company. The plant is supplied with steel plates produced in Brazil—and plates made in Mexico using mineral ore from Brazil. Because the plant provides steel products to several car and equipment manufacturers, most of whom have adopted just-in-time production arrangements, the supply lines for ore and steel plates have to be extremely well-coordinated.

4.25 The effective management of this process requires up-to-date information on supplies, production, and sales—and an extensive and reliable communications system. Information, in effect, becomes a substitute for inventory and other resources—and improves service while keeping costs under control. Although the costs of major production inputs have increased in the last fifteen years, the costs of information have decreased. The quantity, quality, and complexity of information exchanged between buyers, sellers, and third parties have increased considerably in importance with wider acceptance of just-in-time and related processes. The timeliness, accuracy, and availability of information are the single most important service dimension. A study of 1,450 businesses in Canada, Japan, the United States, and six Western European countries found that their managers will attach increasing weight to the availability of reliable telecommunications in the 1990s before deciding to enter new markets or selecting new business partners (Peters 1992). But good communications must be backed by reliable delivery of supplies, which involves not only international transport but also efficient production processes. These, in turn, require reliable power and domestic transport.

4.26 The new production processes require smaller consignments and more frequent shipments. The needed multimodal, worldwide perspective has directly affected transport methods and arrangements. In many regions, ocean transport is now provided with increasing frequency and speed—especially for high-value containerized goods—and with a degree of reliability that enables shippers to adhere to their just-in-time arrangements. Two-thirds of the services into and out of key Pacific ports are provided on a fixed day of the week. Similarly, the long-term shift of domestic freight traffic from railways to trucking has been reinforced because of trucking's greater flexibility in responding quickly to changes in delivery requirements.

4.27 A study of manufacturing processes in Western Europe indicates that of the time taken from the supply of raw materials to final retailing, 2 percent is used in production, 5 percent in transport, and 93 percent in storage at various stages of processing (UN 1987). In some developed countries, the use of logistics to improve this process has resulted in reductions in order cycle time of up to 80 percent, inventory reductions of 30 to 70 percent, and reductions in costs of the final product of up to 30 percent. An important contribution to this has been the liberalization of government regulations preventing competition in transport and telecommunications.

4.28 Studies of specific export commodities confirm the new developments. A study of bicycle and footwear imports into the United States found that the three important product criteria are price, quality, and on-time delivery: "Reliable, complete deliveries are essential for retailers to take advantage of seasonal sales peaks and fashion cycles" (Egan and Mody 1990, para 2.10). Because these peaks and cycles are short, even delivery delays of only a few days can mean lost

sales and substantial markdowns. Similarly, a study of the electronics industry found that competing effectively in world markets requires not only low production costs, but also high quality and rapid delivery times (Dahlman 1990). These require a stronger infrastructure than most new entrants have.

4.29 The new production processes present developing countries with a difficult challenge. Although many have succeeded in diversifying exports and increasing the volume of manufactured exports—though from a low base—they may now be facing a slowdown, in part because of serious logistical constraints. For example, the costs of containerized exports from India have risen to one-third more than the average for competing Asian countries—and the time required to get products to markets is also longer (Box 4.3). The causes include power shortages, capacity constraints in ports, roads, railways, and warehousing, and poor telecommunications. Other key impediments have been outmoded trade legislation and customs procedures, uncoordinated management of infrastructure, and limited availability of information services. As a result, exports and imports face long delays and high costs. Container-handling costs in India are 80 percent higher than in Japan and the United States.

4.30 The situation is similar in many Latin American ports. According to the UN Economic Commission for Latin America and the Caribbean, the cost for handling one ton of steel in Santos, Brazil, was $22 in 1988, compared with $3.18 in Kaohiung, Taiwan, and $3.80 in Rotterdam. The major reasons for the high costs include insufficient investment, government regulations, and union work rules that require overstaffing, prevent work at night, and penalize private terminal operators who handle only their own cargo. Brazil was expected to lose $5 billion in potential exports in 1991 because of high port charges (*The New York Times* 1991).8/

4.31 India's efforts to export computer software have failed to meet expectations, in part because the state of Karnataka has been able to supply only half the contracted demand of electricity, forcing operators to buy their own continuous power supplies. One of the largest international companies has brought in its own satellite dish to assure adequate communications. As *The Economist* reports, this has discouraged exports of computer software and encouraged "exporting highly skilled Indians" (May 4, 1991, p. 70). The few success cases—like horticultural exports from Kenyan harvest to European markets in less than 18 hours and large exports of fresh fruit from Chile—were made possible because of the elimination of bureaucratic red tape that had prevented private companies from establishing effective logistics. Similarly, Indonesia, Malaysia, and Thailand have achieved substantial growth in trade, essentially by establishing liberal regulatory environments.

4.32 Thus, infrastructure services have become crucial for succeeding in industrial dispersal and export diversification. But even if these services are physically available, their effective use is often hindered by government policies involving, cumbersome export license procedures that delay shipments; transport regulations and fragmented and obsolete document requirements that prevent efficient multimodal transport; insurance and liability requirements that don't cover the costs of traded commodities and thus inadvertently increase risks; banking procedures that prevent speedy transactions, such as the issuance of letters of credit; and classification codes for

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8/ A billion is 1,000 million.

local goods and services that don't match international codes. According to Peters, 23 documents are needed to clear imports in India, 118 for exports. Singapore processes 25 percent of its trade and the related transport transactions without documentation.

Box 4.3
Effect of Infrastructure Deficiencies on India's International Trade Chains

Current objectives of country:

Improve export performance in terms of competitive prices and delivery schedules.

Trade chains:

- Imported inputs for car manufacturing and electronics; and
- Exported products such as textiles and garments, shoes, and handicrafts.

Infrastructure deficiencies affecting these chains:

- Power shortages;
- Serious capacity constraints in ports, roads, railways and warehousing. Capacity constraints influence supply schedules, inventory costs, and factor production costs;
- Interruptions in the chain of container movements;
- Poor telecommunications services; and
- Poor connectivity of multi-modal or combined transport capabilities.

Reasons for infrastructure deficiencies:

- Management problems such as:
  - high staffing levels (80 percent higher than Japan and the United States);
  - poor productivity (20 percent output per worker compared with Japan and the United States);
  - union influence and protectionist arrangements.
- Operational problems such as:
  - low equipment availability due to inefficient maintenance practices, obsolete technology, poor management, and lack of spare parts.
- Institutional problems such as:
  - maze of regulations, controls, and interference;
  - excessive documentation requirements (23 documents to clear imports and 118 for exports. It takes 22 hours to prepare documentation).

The effects of these problems on international trade chains are long waiting times and high container handling costs. For example, cargo movements in northern India—the source of 70 percent of India's trade—take 10 to 25 days. Peters suggests that this could be reduced to 3 days. Madras is an exception with very efficient freight management of transported cargo. Container handling costs in India are 80 percent higher than in Japan and the United States. In contrast, Singapore processes 25 percent of its trade and related transport transactions without documentation.

Source: Peters 1992.

How to Build Reliability into Operations

4.33 The concept of reliability has two direct operational dimensions. One is the need to determine the optimum—or most adequate—level of reliability for a group of users. Reliability has to be considered as an economic concept: suppliers and users are only interested in optimizing reliability because of cost. Thus, a cost-benefit analysis of reliability—linking supply and demand in individual markets—is needed. The second dimension is to assess in a particular case whether an action program focused only on enhancing reliability would differ from a conventional program aimed at enhancing the productivity of a whole infrastructure service. This is the crux of the matter: a focus on reliability should also mean looking at productivity from a different—and, it is hoped, more effective—perspective.

4.34 ***Cost-Benefit Analysis.*** A full analytic framework for a cost-benefit analysis of reliability has been developed as background for this paper (Humplick 1991) (Fig. 4.2). The main points are highlighted here.

4.35 To conduct a cost-benefit analysis of reliability, a whole activity cycle—subdivided into smaller cycles—should be the unit of analysis. Whole cycles can be, for example, a multisectoral one focused on a product for export, or any farm-to-market or factory-to-market cycle. The perspective of the whole cycle is in the hands of the user—or a planning agency—but each step might be in the hands of a different supplier. A railway system, for example, is just one subsystem of an international trade chain (Fig. 4.3).

4.36 The next component of a cost-benefit analysis is an analysis of the *suppliers'* options for enhancing reliability. Beyond the obvious point that one way of increasing reliability is to enhance operational efficiency, suppliers can provide redundancy at the design and investment stages. This is a complex technical concept, but a key to assuring reliability of several infrastructure components.9/ The conceptual framework then deals with the *user's options* for reacting to unreliability. Alternatives include continuing to demand the unreliable service, for lack of options; providing alternate facilities, when feasible; exerting pressure, individually or collectively (voice); or reducing or stopping demand for the service by reducing or discontinuing its own production or changing location. The framework then includes the estimation of the costs—private and social—of unreliability and the cost-benefit calculations.

4.37 ***Focusing on Reliability to Improve Productivity.*** An emphasis on reliability—instead of on general agency performance provides a sharper focus on productivity, and, in many cases, points up a need for a multisectoral, multiagency approach. The essence of a sharper focus on reliability is the concentration on the productivity of one or a few activities performed by a supplier, presumably those on which the potential pay-off of higher-quality service is greater—such as container traffic in a port; one section of a railway, one city in a telecommunications network, or one generating plant in a power system. The alternative is the way most analysis of performance is done, taking a whole agency—a port, a telecommunications company, or a railway—as the unit

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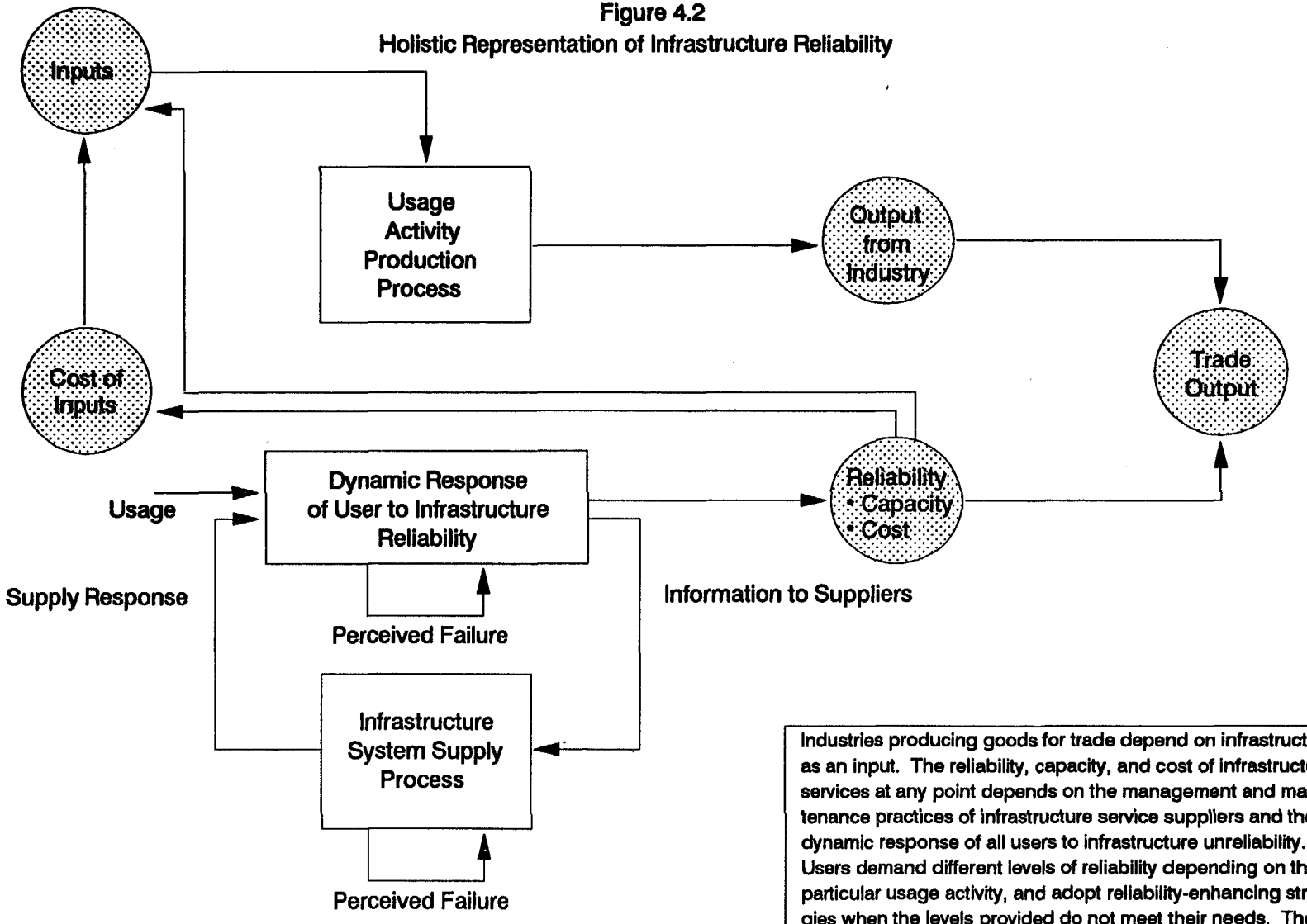
9/ For example, redundant capacity could be *active* when all capacity is used all the time; *passive*, when redundant capacity is dormant and activated only when needed; or *standby*, an intermediate solution.

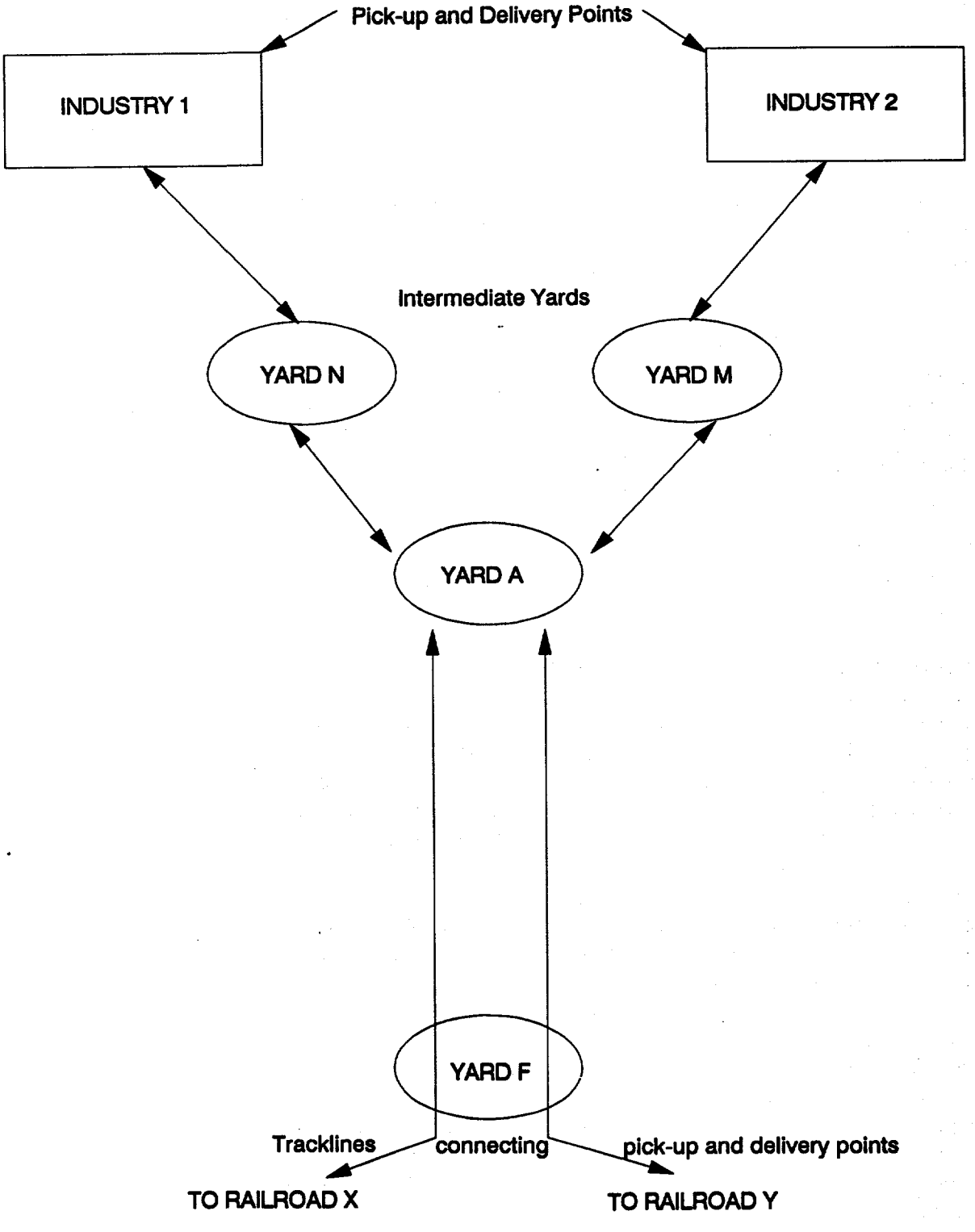
Figure 4.2
Holistic Representation of Infrastructure Reliability



Industries producing goods for trade depend on infrastructure as an input. The reliability, capacity, and cost of infrastructure services at any point depends on the management and maintenance practices of infrastructure service suppliers and the dynamic response of all users to infrastructure unreliability. Users demand different levels of reliability depending on their particular usage activity, and adopt reliability-enhancing strategies when the levels provided do not meet their needs. The extent to which users adopt such strategies can be used as information to infrastructure providers when selecting optimal investment decisions to improve either the reliability or capacity of infrastructure systems.

Source: Humplick 1991

Figure 4.3
Railroad Lines Serving Industry



Source: Humplick 1991

of analysis. The hypothesis favoring the first method is that by concentrating on a more limited activity requiring high standards, the nature of the operational improvements required will become clearer and the potential for improvement greater. The expectation is that the higher operational standards achieved through this method will spill over to the rest of the entity and the pace and nature of progress will be faster and more pointed—that users really needing better services will get them faster.

4.38 This approach has risks. One is that resources could be taken from other services, perhaps reducing their quality and productivity, or the spillover effect might never materialize, especially if the supplier faces many exogenous negative factors. These possibilities must be weighed in each case but the approach looks promising. The alternative, of focusing on an entire agency, has been tried often and has not worked.

4.39 The other way to use reliability to enhance performance is to look at whole multisectoral and multimodal cycles, such as for key exports or for one industry. Interagency coordination would be needed to improve operations over a whole cycle. This full-cycle perspective is particularly useful for planning by a public or private entity—to understand the full implications of an activity and to help identify any bottlenecks in the cycle. A similar analysis can be used for sectoral policy management—for industrial, infrastructure, or foreign-trade policies. Such analysis makes individual suppliers aware of being part of the cycle, allowing for pressure to be put by users or other suppliers in the cycle. The total costs of unreliability become more obvious and quantifiable. More generally, a focus on service reliability gives a clear and quantifiable objective to programs aimed at increasing the productivity of infrastructure suppliers and the quality of service. It helps to make those programs tangible and useful for the clients that need the better services.

Chapter 5

Reorienting Infrastructure Toward Demand: Using Markets and the Private Sector

5.1 As indicated, one of the main causes of the low productivity of infrastructure services in developing countries appears to be their supply orientation—focusing on providing services—largely due to the services' monopolistic position and the tendency of management to focus on the technical aspects of the operation. Thus, this report is mainly about the need to increase the productivity of infrastructure services through a stronger demand orientation. A key ingredient for achieving such an orientation is institutional development. This paper concentrates on two institutional approaches for enhancing that demand orientation. First, it assumes that competitive markets and broader participation by the private sector are the most effective avenues for achieving a demand orientation. Such an approach is discussed in this and the next chapter. Second, if competition and private sector participation are not feasible, their effects need to be simulated through competition surrogates. Two surrogates particularly relevant to infrastructure are administrative decentralization and increased participation by clients and beneficiaries. These surrogates are reviewed in Chapter 7. The analysis assumes that countrywide policies and institutions—such as trade liberalization—are designed to induce competition.

5.2 Of course, other institutional issues also are important for enhancing infrastructure productivity. Traditional institutional strengthening and sectoral policy reform will continue to be central to the Bank's strategy. After all, infrastructure projects have had greater success in achieving institutional development objectives than have most projects in other sectors.

The Role of Competitive Markets

5.3 Much has been said about the role of competitive markets in achieving an efficient allocation of resources. But only recently has the focus been extended to seriously analyze markets' effects on the *use* of resources. A fundamental characteristic of competitive markets is that they provide incentives and disincentives for effective institutional performance. Competition causes pressure—reducing discretionary behavior in an organization, and imposing a discipline that leads to improved performance. For these reasons, the simplest, most effective way to achieve a demand orientation is to expand the realm of competitive markets. The larger the proportion of infrastructure services that can be operated in reasonably competitive environments, the better. The analysis for this paper concluded that the scope for competitive markets in infrastructure can be expanded in most developing countries, but that the potential for these markets varies considerably among sectors, some of which should remain public entities. In addition, the government's regulatory capacity is a key component in the role that competitive markets can play.

5.4 ***Expansion of competitive markets.*** There are three main ways to expand competitive markets in infrastructure. One is to adapt technological innovation to reduce economies of scale and allow the participation of a larger number of suppliers, or permit pricing of services where that was not possible before. The second, often closely related to the first, is institutional—including

legal—innovations that restructure or divide markets in a way that allows participation by a larger number of suppliers. The third option is to dismantle the disabling environment, eliminate the web of regulations, restrictions, and government interventions that prevent the functioning of markets. Regulation likely will still be needed to establish a level playing field.

5.5 The conventional wisdom about the monopolistic nature of many infrastructure activities stems from technologies available decades ago. Those technologies have evolved considerably in recent years. For example, new technology in thermal power generation makes it economical to generate power on a much smaller scale than before. In addition, institutional changes can separate power generation from transmission and distribution—with the distributing entity having more of a monopolistic position. Technological innovations in telecommunications also allow more competition by making possible the provision of different types of services by a number of companies. The tremendous progress in the last two decades in developing decisionmaking tools and database systems has helped infrastructure services that are complex and management-intensive, such as railways, to enhance their capacity to operate competitively. Other developments—such as metering for water and other utilities or mechanisms for road pricing—have also allowed more market-like operations.

5.6 However, technological change is still treated as an exogenous development. What has not been done is to turn this perspective around: because competitive markets are now seen as one of the most effective ways of increasing the productivity of infrastructure, technological innovation should be directed toward that goal. This issue needs to be explored further.

5.7 The numerous institutional innovations that allow the expansion of competition have occurred mostly in developed countries. Most important have been the attempts at breaking up previously large infrastructure entities to allow competition among the parts or with other entities. Typical among these are the subdivision of national power, telecommunications, or water-supply companies into regional or functional units; the breakup of railways into companies handling different types of services—freight, passenger, and suburban—or companies for maintaining the tracks and others for running services (Moyer and Thompson 1992); and the breakup of ports into companies running individual berths or services and competing with each other. Among these changes, it is necessary to distinguish those that genuinely result in more suppliers serving the same market from measures that are forms of decentralization—such as regionalizing a national water company.

5.8 Competition can also be enhanced through contestability—competition for the market—a particularly important avenue for infrastructure (see Baumol, Panzar and Willig 1982). The scope and techniques for making markets contestable have been developed considerably in recent years. The potential is high for a number of activities that would continue to operate as monopolies or quasi monopolies in the public sector: water supply, ports, airports, toll roads, and power transmission and distribution. How to improve the effectiveness of contestability is an important task in this respect. This subject is further discussed in the next chapter, around the issue of concessions.

5.9 One form of extension of competitive markets that is becoming prevalent could be called "competition within the supply," in which public entities providing infrastructure sub-contract through competitive bidding to other public or private entities to undertake a number of activities: maintenance, repairs, fee collection, or the running of specific services. Insofar as there is no

collusion in the subcontracting, this has proved to be an effective way of introducing competition and enhancing operational productivity.

5.10 ***Sectoral differences***. Some infrastructure subsectors lend themselves more easily to competitive markets than do others. The potential depends on how much each subsector approximates a private or a public good. Criteria for distinguishing between public and private goods are *excludability* and *subtractability,* or the *degree of jointness of consumption.* The more a good exhibits these traits, the greater the chance that it can be operated competitively. Another important characteristic is that some nonpublic goods may also be natural monopolies (Triche 1990; Savas 1982).

5.11 Excludability is the degree to which a potential user of a good or service can be excluded if the user does not meet conditions set by the supplier. Although excludability is easy for many goods—for example, goods with a unit price in a store—excludability varies, depending on the cost-effectiveness of allocating the goods. The impracticality of excluding individuals raises issues of free-riders—who can consume a good or service without paying. For example, one problem in allocating road maintenance costs is identifying who should pay, because excluding free-riders is impractical. Similarly, difficulties in supervising electricity consumption in squatter settlements means that cost allocation among users requires increased monitoring. How to assure that those who consume share in the cost of production is not simply a choice of market production versus government production. And, even when government does not produce the good, it still can help organize production.

5.12 Subtractability refers to how much one user's consumption of a service subtracts from the ability of others to consume without raising production costs. Different types of infrastructure services have different degrees of subtractability. For example, highway use by one vehicle usually does not affect use by others. Yet, at certain thresholds of use a highway may be congested or deteriorated. Upstream pollution in water systems or irrigation subtracts from the ability to consume downstream. Often, there has been a tendency to create excess capacity in power generation, so that consumption by one does not affect the availability for others.

5.13 These two characteristics can offer a fourfold classification of goods (and services): *public goods,* with low subtractability and low excludability; *private goods,* high subtractability and high excludability; *toll goods,* low subtractability and high excludability; *common property goods,* high subtractability and low excludability (Table 5.1). This tentative classification offers a first cut at the determination of appropriate institutional arrangements. The two extremes suggest in principle government (public goods) or competitive-market (private goods) ways to provide infrastructure services, although the institutional alternatives for toll and common-property goods are less straightforward. The practical issue is how far toll and common property goods can, through technological and institutional developments, approach the conditions of private goods and be operated under competition. The exact potential in each case will depend on factors such as market size and the macroeconomic and institutional frameworks.

5.14 For more private goods, reliance on external competitive forces—where contestable markets apply—becomes more appropriate. But for more public goods, the use of competition surrogates becomes essential. One clear example of the difficulty of applying competitive market

Table 5.1
Infrastructure Potential for Competition

Subtractability	Excludability: Low	Excludability: High
Low	**Public goods** urban roads local rural roads waterways highways wastewater treatment	**Toll goods** toll highways telecommunications ports airports urban water systems power transmission power distribution
High	**Common-property goods** irrigation systems rural water systems hydro power generation thermal power generation storm drainage	**Private goods** road transport urban transport rail transport water storage on-farm irrigation

criteria is in roads—it is in everyone's interest to use the service, but in no one's interest to pay for it. Because it is difficult to exclude individuals, roads are overused. However, this is one of the cases in which technological developments, such as electronic pricing, might change the economic nature of the activity by making cost-recovery feasible, at least for some roads. Some forms of infrastructure lend themselves to combinations of alternatives—such as when generation and distribution of electricity can be separated. Although there are few economies of scale in power generation, a fairly competitive market might be possible, but transmission and distribution might have to operate as regulated monopolies.

5.15 The potential of competitive markets for infrastructure services in "average" circumstances is much higher than was presumed only a few years ago. But, equally important, some services likely will never be suitable for competitive markets—such as most interurban highways and urban roads, large water supply and main irrigation networks, and hydro power generation. These might be closer to defense and the administration of justice than to road transport or telecommunications. Governments must accept that these activities are likely to remain in the public domain as monopolies. For highways, the Infrastructure and Urban Development Department's paper on user charges and accountability suggests several ways to simulate competitive

pressures through administrative and other means (Heggie 1991). It is unfortunate, however, that the emphasis on the importance of competitive markets and privatization has deflected attention from the need to continue exploring ways of enhancing the performance of monopolies and quasi monopolies (Chapter 7.)

5.16 Toll and common property goods also have serious and difficult problems. For example, with common property goods such as some water systems, one of the difficulties is how to assure that individuals have incentives to contribute to production and conservation. If individuals cannot be excluded or if the group is too large to hold individuals accountable, free-riders may obtain.

The Private Sector Role

5.17 There has been increasing pressure to find alternatives to public provision of infrastructure services. Motivating factors include heavy claims on current revenues and a lack of borrowing capacity that limit governments' abilities to finance major investments—while demand for many types of infrastructure is rising faster than population or income. And the opportunity cost of donor funding of investment is rising as donors have expanded into policy-based lending. Other factors encouraging privatization are that public sector management capacity is stretched thin and that some governments have been convinced by efficiency arguments that private investment is more efficient than public investment (Bennet 1981; Butler 1985; Hatry 1983; Roth 1987). Although the most powerful way to achieve a demand orientation is through the private sector in a competitive market, the current push to privatize infrastructure may prove excessive. The potential for privatization varies among subsectors. Even for subsectors that have good potential, other factors must be considered before designing privatization policies for infrastructure (World Bank 1992).

5.18 ***Privatization as a continuum.*** Private sector participation can take different forms. The easiest and most obvious one is a service provided by a fully private operator, but other alternatives include joint private-public ventures, contracting out, franchises and concessions, a variety of build-operate-transfer (BOT) schemes, and voluntarism and self-help. BOT and concession schemes are analyzed in Chapter 6. Aspects of voluntarism and self-help are reviewed in Chapter 7.

5.19 ***Preconditions for private sector participation.*** Aside from a suitable legal and institutional framework at the country level, preconditions for successful private sector participation are a competitive environment or, alternatively, an effective regulatory capacity; suitable players; and careful planning of the privatization.

5.20 Many privatization efforts have not paid enough attention to the competitiveness of the relevant markets. Collusion and oligopolistic behavior may require careful regulation—for example, in the Belize Second Road Maintenance and Rehabilitation Project and the Guatemala Secondary Road Maintenance Project. Both projects call for contracting out maintenance, yet neither says much about the need for a viable and competitive private construction industry which is virtually absent from both countries. Similar conclusions are reached by Moore and others (1987), who studied contracting out in Honduras, stressing also the need to examine the political, legal, and regulatory environment. They conclude that allowing the private sector to operate without a

competitive environment may lead to inefficiency, collusion, and the skewing of supply. Part of these negative effects can be mitigated by allowing foreign firms to participate alongside domestic firms, as is done in Guatemala and Honduras. Where natural monopoly conditions prevail—as in water supply—the negative effects can be worse (Triche 1990).

5.21 A good example of an effort to build private sector capacity while encouraging competitiveness is the Zimbabwe Second Highway Project. The Bank and the government agreed to use a mix of contractors and public construction units, some of which were to be force account (work done by the staff of the public agency). These force account units were to receive payment based on the average rate for competitive bids for similar works—the units' rental of equipment and vehicles at lower-than-market rates was a partial subsidy. The rationale for subsidies during an effort to encourage competition is that they assure some continuity of delivery. The issue of continuity is not limited to developing countries. A common concern in the United States in contracted service delivery is the potential for service disruption because of strikes, bankruptcies, or slowdowns by private business. If part of a service continues to be conducted by government, the potential for such occurrences is reduced. New York City contracts out garbage collection but retains a small fleet to assure a minimal level of continuity, to prevent oligopolistic behavior, and to assure competitive pricing from the private sector (Stevens 1987). And, to prevent successful original bidders from taking unfair advantage in subsequent bidding rounds, an "independent"—in this case, government—standard for measurement has proved useful. This practice might be even more important where preexisting levels of competition are low or where local monopolies exist.

5.22 The construction industry is another example. Kirmani (1987) has identified key policy bottlenecks in the development of domestic—private sector—construction industries. Despite vast activity involving construction, the Bank's record in the development of domestic contractors is grim—partly because of weak government commitment to develop the industry outside the government's immediate purview. In part, the problem is an inappropriate policy and institutional environment. Some of the more serious bottlenecks include a lack of government interest in the problems of the construction industry; poorly administered procurement procedures; difficulties in importing equipment, parts, and materials; inadequate institutional arrangements for credit, bonding, and insurance; and delays in payments to contractors. Thus, special allowances often are needed for the development of private contractors. For example, in the Madagascar Seventh Highway Project, all rehabilitation and periodic maintenance work is to be contracted out. To help in the development of the industry, a comprehensive training scheme has been prepared—for which contractors will compete to enter—and field works will be conducted with tutorial management assistance, coordinated through a training arm. After training, contractors who have performed successfully will be approved for bidding. The project also envisages providing payments up front to ease liquidity problems for local small bidders.

5.23 The Malawi Northern Transport Corridor Project has made a conscious effort to ensure incentives for private sector development. Malawi Cargo Centers are to be established to be responsible for cargo operations. Three entities are to be involved in ownership and management: the government; a parastatal and parent company of Malawi Railways; and a mixed enterprise comprising Malawi private sector investors, Malawi Railways, and the Petroleum Control Commission. The government will transfer assets to the parastatal. These assets will in turn be leased to Malawi Cargo Centers companies—which will manage, promote, and market the use of the

facilities and the Northern Transport Corridor. The intent is to reduce risk and to encourage private sector involvement. These arrangements provide incentives for all parties to perform well. The parastatal responsible for supervising the use of assets and facilities has a direct financial interest in the success of the Malawi Cargo Centers. And the expectation is that the financial performance of other transport services will be improved with the success of Northern Transport Corridors. Private investors—although not bearing the entire risk of the venture—will share in gains and losses. The ultimate guarantor is the government.

5.24 In Côte d'Ivoire another form of private sector participation is the use of leasing —*affermage*—in which the municipality constructs a facility and contracts with a private firm to operate and maintain it. In this case, the government contracts out for Abidjan's water supply to the Société de Distribution d'Eau de la Côte d'Ivoire (SODECI), a private entity. The government retains control of price setting and the municipality receives a fee for the amortization of the construction costs (Lewis and Miller 1986). Several inconsistencies have hampered SODECI. Until 1987, SODECI was compensated for shortfalls. And because investment decisions resided in the (centralized) Water Directorate—with no risk to SODECI—optimistic estimates of potential consumption led to overinvestment. This was particularly true in rural areas, where overdesign and overconstruction, weak monitoring by SODECI, and the failure to incorporate community initiatives led to a cross-subsidy of rural water by high tariffs on urban users. (Côte d'Ivoire Water and Sanitation Project 1990; Triche 1990).

5.25 In fact, in many contractual arrangements the major issues are costs and risks—and ways can be found to reduce these burdens on the private sector. In the United States local and state governments regularly form public-private partnerships to provide many infrastructural services. Lease buyback schemes have been widely used. The public sector's capacity to finance large-scale construction underlies the initial investments. These are then leased to the private sector for operation and maintenance and a fee is paid to the municipality for the amortization of the initial debt burden. This practice is increasingly common with airports and other facilities, where the up-front costs and risks to the private sector are high (Pagano and Moore 1985). Maintenance costs become a responsibility of the lessee. The applicability of these relationships to developing countries is large where the burdens of the lumpiness of initial investment and the issue of risk are yet more problematic, but where the need for ensuring accountability and operational efficiency is higher.

5.26 A final important precondition in many developing countries is the public sector capacity to prepare the units for privatization. Although in most cases public enterprises should be privatized without attempting to restructure them, restructuring or downsizing, if it is necessary, is a highly technical undertaking for which few governments have the capacity in the right places. To prepare and negotiate a deal—for example, the price and methods of financing—is also highly technical. Such expertise can be bought from investment banks or consultants—at high cost—but the public sector still needs the capacity to negotiate with the bankers or consultants, to evaluate their work, and to ensure that the consultants' recommendations and actions are in the public interest. To have this capacity does not require a big organization, but a few well-qualified professionals with technical and political independence (Israel 1990). A recent study of municipal solid waste services in Latin America offers an important word of caution in this respect.

> The existence of public agencies that are capable of negotiating and monitoring contracts efficiently without unnecessary burdens on private operators is important. Unfortunately, [public] municipal waste managers in developing countries too often have no professional preparation in the field and turnover is high, preventing continuity and coherence in dealings with the private sector. Training and technical assistance in this area can be provided through municipal strengthening projects financed by the Bank and other[s]..., (Bartone and others 1990, p. 9).

The Central Role of Regulation

5.27 Perhaps the most important—and most neglected—aspect of the institutional reforms under way in most developing countries is the need to regulate public—and private—sector infrastructure services. This is a key counterpart to the larger role of competitive markets and the private sector. Liberalization policies mean that governments will no longer supply the services directly or regulate prices and quantities produced, but still need to regulate the functioning of competitive and noncompetitive markets. Infrastructure services require three types of regulation: for competitive markets, for monopolies or oligopolistic markets, and for the subcontractors of public enterprises or agencies.

5.28 First, even in fully competitive markets—rare in infrastructure, except perhaps road transport or coastal shipping (if it is open to international competition)—the government must regulate to ensure that the rules of the game are clear and equally applicable to all participants. Regulations set technical and safety standards, labor laws, and financial and environmental standards. The environmental standards may have important economic trade-offs that usually require extensive negotiations. And even if a market is competitive, governments need minimal monitoring—not intervention—to ensure that the market remains competitive, that entry is unrestricted and that no collusion among producers is occurring.

5.29 Second, for monopolies and oligopolies the government task is much more complex. Government must oversee the monopolies and be able to intervene with regard either to prices, investment levels, rates of return on assets, or other measures of performance—if such indicators suggest the monopolistic power is being misused. Much has already been written about this topic. Third, an often-overlooked aspect of regulation is *internal* regulation—when public enterprises or central agencies contract out or provide licenses to private sector operators to perform a number of tasks. This is in contrast to *external* regulation, performed by government agencies. The public agency needs to have the internal capacity to monitor the contractors and ensure that the work meets specifications. In other words, the agency becomes the regulator for these contractors.

5.30 ***Dismantling the disabling environment.*** An effective regulatory strategy also needs to dismantle the disabling environment by eliminating unnecessary regulation (and the attendant bureaucratic red tape). Much of the decline in the productivity of infrastructure services in recent times has been attributed to the uncontrolled and contradictory expansion of the regulatory and legal framework associated with "doing business." Where private entrepreneurs might provide specific services—for example, local small-scale transport, rural road maintenance programs, rural road construction programs—the burdens of compliance with overly sophisticated standards discourage responsive behavior. Entrepreneurs facing severely circumscribed opportunities to compete—and

unable to change government policy through the use of voice—walk away from ("exit") formal markets (Hirschman 1970).

5.31 In the Pakistan Power Project, despite efforts to create incentives for private sector participation, private sector interest was declining. In 1985, the government announced incentive measures to encourage private sector participation—for example, special fiscal incentives, an extension of income tax holidays, and exemptions on import duties on equipment. Yet, response remained weak. Studies conducted before appraisal suggested that a principal impediment to private sector participation was the evaluation and review process. Cumbersome procedures involving undertrained staff became sources of incredible delay. Pressure to speed up reviews led to ad hoc evaluations, uncertainty, and inconsistency—and disinterest by investors. In the Colombian Power Sector Adjustment Loan (12/87) it was noted that for greater efficiency and effectiveness in energy production, there was a need to address the "highly legalistic regulatory environment." Lengthy and time-consuming local regulations and procedures affect every aspect of project implementation.

5.32 The need for procedural reform is also an issue for donors. Carapetis and others (1984) point to the consequences of rigid standards of road construction requiring expensive capital-intensive methods when local community-based alternatives often work better. Also, excessive regulation can have other negative effects. In the Philippines officially sanctioned fare structures often presume operation on all-weather paved roads. Thus, private operators rarely seek permits on unpaved roads. As a result informal transporters operate on these sections and charge as much as two-to-four times the rate officially set for "good" roads. The consequence is a disenfranchising effect and few pressures from operators to improve those roads.

5.33 In other cases, the issue is one of inadequate enforcement of regulations. In the Colombia Seventh Highway Project, one major issue was the government's willingness and interest in enforcing axle-load and dimension regulations. Failure to enforce these regulations means rapid deterioration of road systems. Another common example is the inability—often the legal incapacity—of suppliers to prevent the unauthorized use of a service, resulting in less than full cost recovery. This is especially relevant in water and power. The result is reduced incentives for efficient production—and inefficiencies in allocation and distribution. In the Second Manila Water Supply Project, high levels of unaccounted-for water were recognized by a reasonably competent water authority. When that authority attempted to expel illegal users, however, much time and effort were needed to obtain legal judgments because of the bureaucratic nature of the legal process, and the authority recovered only part of the value of the illegally consumed water. Existing penalties appear to be inadequate to deter illegal use. And numerous studies of rural water supply have pointed to failures of project design to consider the potential diversion of water for nonhousehold use in agriculture. Churchill and others note:

> Experience has shown that rural villagers have often diverted water intended for drinking, cooking, and washing to irrigating crops...This is particularly true where water is made available in large quantities through the use of piped distribution systems. Villagers in Senegal and Nigeria, for example, were found to be tapping a large percentage of their piped water for agriculture... (1987, p. 53).

5.34 In Burma's Second Telecommunications Project a similar problem arose with the inability to enforce pricing policies and collection. The government prohibits the disconnection of services for nonpaying customers for a full year. The result is weak internal incentives to collect and a loss of operational efficiency. A similar, yet more dramatic, case can be found in Indonesia, where government is the delinquent. The major reason for low levels of collection was the arrears of other state enterprises. Bill collection by the National Electricity Authority for nongovernment customers was generally satisfactory: the accounts receivable fell below two months' billing. In contrast, outstanding government accounts receivable represented more than one year's billing in 1981-82 (World Bank 1988a, p. 47).

5.35 ***Improving the regulators.*** To ensure that infrastructure operators meet safety, financial, economic, and other standards, governments need an institutional capacity of higher quality than is traditionally found in regulatory agencies in developing countries. A regulatory agency needs to be able to acquire and process all relevant information from the regulated units and elsewhere; conduct technical, financial, and economic analyses of the regulated units and the subsector; coordinate with other public and private entities; and interact with and prevail over the regulated units. These functions are difficult to perform well in any circumstance, but particularly in developing countries. They require high-caliber staff with enough prestige, status and independence from the regulated units to deal with other government entities on an equal basis.

5.36 For example, a regulatory agency for water supply, overseeing a few private water companies operating as regional monopolies, would need several economists and financial analysts—to monitor operating costs and the financial evolution of the water companies, and be able to link the water sector with the rest of the regional and national economy. The agency also would need staff to cover the technical aspects of regulation, and perhaps social science professionals to deal with related social issues. In an average country the numbers of required staff would not be large, but would have to be preferably of a higher professional level than those working in the regulated units.

5.37 Few countries appear to have thought through the government capacity needed to regulate their private sector strategies. The new regulatory agencies are more like think-tanks than traditional bureaucracies and most public sectors in developing countries are not able to attract and retain the needed high-caliber staff. Other areas also are competing for such staff (Israel 1990). Efforts are beginning in developing countries to tackle regulation systematically. For example, the main objective of a recent technical assistance project for telecommunications in Mexico has been to help develop a regulatory capacity. If past experience is any guide, however, the private sector-oriented strategy will not succeed unless the regulatory capacity proves to be first class. Witness the difficulties developed countries are having effectively regulating infrastructure. Water, telecommunications, electric power in the United Kingdom, and the airline industry in the United States are cases in point.

Chapter 6

Alternative Mechanisms for Private Sector Financing of Infrastructure

6.1 Infrastructure investment is still a public sector responsibility in most of the developing world. But governments have begun exploring or encouraging private financing of infrastructure investments and services. This chapter reviews some of the newer or less familiar options available to governments. Three main types of financing techniques are analyzed: (i) investments to build, operate, and then transfer a system to the government—usually called BOTs but with many variants, including concessions, which usually entail rehabilitating an existing system, and development gain, which captures some of the positive externalities of infrastructure development by giving the private investor the right to develop adjoining property; (ii) self-help, including everything from cooperatives delivering telephone services to power cogeneration to feeder road construction; and (iii) bond financing. The chapter begins with definitions and illustrations of these techniques and presents an inventory of existing projects, showing the extent of their use in developing countries; reviews the cost and benefits of private infrastructure investment, using the BOT approach as example; and draws conclusions on private investment potential in infrastructure.

Types of Financing

6.2 ***Build-operate-transfer and variants.*** BOT projects involve a private company—usually a consortium led by an international construction company—that finances, builds, and operates an infrastructure system for a fixed time during which the government has a regulatory and oversight role. BOT projects are designed to generate enough revenues to cover the project company's investment and operating costs plus an acceptable rate of return on capital—usually 15 to 20 percent. At the end of the project, usually in 15 to 25 years, the system is transferred back to the government. BOT projects were originally conceived to transfer commercial risks to the private sector and thus free government funds for other uses. To date, lenders and project companies have been reluctant to commit to a project under nonrecourse conditions, so a government guarantee is usually negotiated. BOT arrangements are deal-specific, with the allocation of risk among creditors, the sponsoring government, and the project company varying significantly by project. The actual allocation of risk is perhaps the key to a project's attractiveness to the participants.

6.3 One of the most successful BOT projects to date has been Hong Kong's East Harbor Crossing, a combined road and rail tunnel under Victoria Harbor, which was financed entirely through the private sector using long-term franchises offered by the government. The project is managed by a private consortium, which put up equity worth 29 percent of project costs. Observers attribute Hong Kong's success in organizing and executing this and other BOT projects to careful project appraisal, competitive project bidding, and the government's willingness to bail out the project in case of financial difficulties. The government has also been willing to support private investors by rearranging its own priorities to provide necessary ancillary investments, such as access roads. In return, the project company has assumed all commercial risks.

6.4 The Bank is helping to set up Pakistan's first BOT project—a 1,292-megawatt oil-fired power plant to be located near the mouth of the Hab River. Total project costs are estimated at $1.1 billion to $1.3 billion with 20 percent equity financing from a combination of project sponsors and convertible bond issues; 30 percent of funding from Pakistan's Private Sector Energy Development Fund, created partly with Bank funds; and 50 percent from commercial lenders and export credit agencies. After more than four years of preparation time, construction is expected to begin in mid-1992. The project has been slowed by the need to establish laws and regulations concurrently with project negotiations.

6.5 A project frequently held up as an example of everything that is wrong with the BOT approach is the Gazi power plant in Turkey. After six years and millions of dollars in development and negotiation fees, this BOT contract for a 1,000-megawatt plant has still not been awarded. Problems with this project have included the inexperience of the government and the sponsors with this form of contracting and their subsequent shifting demands on such issues as risk allocation and tariff levels. An additional problem has been poor organization of the competition for contractors and designs. The International Finance Corporation, among other creditors, has pulled out of this project and its fate is uncertain (Table 6.1 compares the terms of these three projects).

6.6 In the decade since the term BOT was coined, several variations have been spawned (Table 6.2). For a refurbish-operate-transfer (ROT) project in the Philippines, a project company shipped in an old power plant, refurbished it, and brought it on line in much less time than it would have taken for a green field investment. Develop-built-operate (DBO) is a new idea being proposed for at least two urban transport projects (Ankara and Karachi), in which the project company assumes no commercial risk initially but is financially accountable for building and operating a system within performance specifications. The company then assumes commercial risks incrementally and conditionally as the government sets up appropriate regulations and capital markets.

6.7 ***Concessions.*** Concessions are an older form of the BOT idea in which a private company contracts with a government to build or expand and operate an infrastructure system for an agreed-upon period of time during which it bears full commercial risk. The company pays a fee to the government and is responsible for all investment and maintenance during the concession period. Compensation is through tariff revenues; contracts are designed to be long enough to allow concessionaires to recoup their investment. Concessions are typically in water and sewerage and are most common in France, Spain, the former French colonies, and some countries in Latin America.

6.8 In Côte d'Ivoire, the operation of Abidjan's water supply system began as a lease contract awarded following a competitive bid in 1960. As indicated (para 5.24), the contract was revised in 1987 to give SODECI, a private entity, a full-fledged concession. The water supply system is one of the best-operated but most expensive in Sub-Saharan Africa. The new contract reduces SODECI's compensation but increases its autonomy in investment planning and execution in the urban water sector. This adjustment was a response to criticisms that fragmented responsibilities had led to a lack of accountability and efficiency. In the past thirty years, Ivoirians have taken an increasing role in the management of SODECI and most of the company's equity is now held by private Ivoirian stockholders.

Table 6.1
Comparisons of Terms of Three BOT Projects

ıe	Total Est. Cost	Equity	Debt	Preparation Time	Return on Equity	Bid?	Concession Period	Government Support	Financing Structure
ıg Kong ast Harbor rossing	$500 million	29%	71%	2 years from bid tender to contract; est. 4 yrs construction	Unknown	Yes	30 year road franchise; 22 year rail franchise	Govt. franchise allows full access to road and rail revenues along route; commitment to construct of supporting infrastructure	Equity: - 100% from sponsors Debt: - 80% revolving credits - 20% installment sale facilities
istan ab River ›wer Plant	$1.1 billion - $1.3 billion	20%	80%	Unsolicited bid received 12.87; construction not yet begun	18 - 23%	No	23 years	Security package includes: subordination of government debt; force majeure; inflation; foreign exch; fuel supply; tax exemptions; protection against change in tax or duty levels; predetermined price set to guarantee real return on invt	Equity: - 60% from sponsors - 40% convertible bonds debt: - 65% export credit agencies - 35% Private Sector Energy Development Fund
key azi Power lant	$1.3 billion	20%	80%	40 months since bid submitted; status uncertain	16%	Yes	26 years	Take or pay; tax waiver; forex guars; force majeure; subord'd govt debt to be issued to cover operational shortfalls	Equity: - 67% sponsors - 33% Turkish government Debt: - 100% export credit agencies

Table 6.2
BOT Variants

BOO	(build-own-operate) in which there is no transfer back to the government
BOOT	(build-own-operate-transfer) with a special "T" for transfer and training
BROT	(build-rent-operate-transfer)
DBO	(develop-build-operate).
ROT	(refurbish-operate-transfer)

6.9 Although BOTs and concessions are similar contractually, they have carved out distinct market niches. BOTs—the emphasis tends to be on the "B," the building phase—and consortiums are usually headed by an international construction contractor. Concessions, on the other hand, focus more on the management of a system, usually a utility, and their consortia are usually led by a European utility company. Although BOTs tend to be stand-alone projects from scratch in the power generation or transport sectors, concessions are usually awarded for the expansion and operation of existing water or power utilities.

6.10 The difference between concessions, lease contracts, and management contracts needs to be kept clear—although the three may overlap or be combined. Concessions are a contractual arrangement in which a private company invests in new infrastructure. Lease contracts, as defined by Vuylsteke (1988) share some of the characteristics of concessions—a contractor pays a fee to government in exchange for the right to operate and maintain a facility according to commercial criteria for a fixed time. But the contractor is generally not responsible for new investment. Management contracts are a step further removed from concessions. Here, a company is hired to operate an infrastructure system for a fixed-fee with no financial exposure. All risk rests with the government.

6.11 ***Development gain.*** A financing technique that has become popular in the countries of the OECD is known as capturing development gain. Using this technique, some of the positive externalities of new infrastructure investment are internalized by giving the private investor the right to develop adjoining property and thus enjoy some of the benefits the investment creates—notably

higher property values. This technique, which requires large land holdings and a sophisticated property development sector, has been used successfully in Hong Kong and is proposed in Thailand. Hopewell Holdings, one of the major players in BOTs has gained cabinet-level approval on a $2.8 billion bid to span Bangkok with 60 kilometers of mostly elevated rail and 48 kilometers of highway. The proposal is for a BOT-like contract in which the government would provide neither equity nor financial guarantees. Hopewell would put in equity worth 10 to 15 percent of project costs and would earn much of its return through building and leasing retail space in the rail stations. Some income from the real estate developments would also subsidize rail fares. Hopewell would pay the state rail system, which owns the properties, a fee for access to these properties over the anticipated thirty-year life of the contract.

6.12 ***Self-help***. Mobilizing labor and capital to construct small-scale, local infrastructure is one of the most common techniques for supplementing public resources—with varying degrees of organization and varying amounts of state support or opposition. What the projects in this category share is the smaller-scale, self-help element of the initial investment—even if the eventual size of the enterprise is substantial—for example, an electrical cooperative in Santa Cruz, Bolivia, had grown to 50,000 members by 1981 and was providing power to that city and more than 80 nearby villages. In some cases the net effect is large; China is estimated to have some 100,000 30-kilowatt minihydro projects. Water, power, and telecommunications cooperatives prevail throughout Latin America and Asia—and feeder road construction and maintenance are managed locally in many African countries.

6.13 Often labor contributions reduce the financial cost of these investments. For example, in the Banglung District of Nepal, local communities successfully constructed sixty-two suspended bridges through a combination of local inputs and government funds. Although the national government provided some special materials, the local communities provided all of the locally available material and labor. Households not able to participate directly in the construction were asked to contribute food or money. Costs to the government totaled only about $50,000—and the amounts mobilized locally were substantially greater.

6.14 At the high end in terms of local financial input, cooperatives throughout Latin America provide telephone services in towns or villages. Typically, cooperative members finance the purchase of a small exchange, cables, telephone sets, and other necessary equipment for a local telephone network, which may or may not be hooked up to the national system. Such rural telephone cooperatives have operated for decades in Brazil, where the cooperatives can connect their subsystems to the national system, subject to technical standards and usage charges. Experience in the Sao Paulo area shows that the rural telephone cooperative system is particularly effective in mobilizing local participation and private investment funds. Initial and recurrent costs are said to be lower than those of the national utility because of the lower costs of local labor, some self-construction, low overhead, and the use of simple technologies.

6.15 Perhaps the most dramatic form of self-help is the substantial investment by private enterprises in generating capacity for their own use in response to frequent power outages or unsteady voltages. This power is essential to the functioning of many developing economies; in Indonesia, captive capacity totals an estimated 4,600 megawatts compared with 6,420 megawatts installed by the public power corporation. Another outstanding example is private investment that has replaced public investment in tubewells, as in Pakistan, or public investment in large-scale

irrigation facilities—as in Nigeria where between 1984 and 1989 almost 9,000 northern Nigerian farmers invested in shallow tubewells and pumps. The investments households make to deal with infrastructure unavailability or unreliability—especially in water and sanitation and power—also are a form of self-help. These investments can be substantial in some economically powerful households but, as indicated, are more important relative to income in poorer households.

6.16 ***Bonds and infrastructure banks.*** In many Asian and Latin American countries, public utilities issue government-backed bonds to raise private capital. Municipal bonds are rarer because most municipalities are not creditworthy and can get money more cheaply through some other vehicle such as central government allocations, local taxes, or donor funding. A common constraint to bond financing in developing countries is weak local demand for investment instruments. Public financial managers have been able to circumvent this low demand in several ways. In Pakistan, securities have been issued denominated in foreign exchange to encourage overseas savings repatriation. Other countries have made bond purchases compulsory. For example, the municipality of Taegu City, Korea, is financing roads through a bond issue. All residents wishing to register their vehicles must purchase these bonds. Thus, this transport infrastructure will be financed by potential users. In Brazil, ELECTROBRAS, a holding company with equity in roughly ninety utilities, gets its revenue from loan repayments and what are essentially compulsory loans from the larger electricity consumers who must pay a billing surcharge each month. At year's end, the customers receive long-term bonds as compensation for these payments. In addition, utility or road bond issues carrying government guarantees are often bought up by national pension funds, providing a valuable stimulus to local capital market development. A good example of this practice is the bonds that have been issued to finance Indonesian toll roads.

6.17 Infrastructure banks are a public targeted-lending facility, typically found in Latin America and financed through a combination of bond issues, government funds, and external donor support. The banks onlend their capital to local governments for infrastructure investments. Loans are often guaranteed by the national government. Infrastructure banks mobilize domestic funds for investment and offer an attractive vehicle for donor funding; the World Bank has helped fund twenty-six such banks. Most of these eventually collapse under the weight of bad debts. Their financial difficulties usually stem from lending at below-market rates and having the government-guarantee facilities bear most or all of the risk on the loans.

6.18 An exception is Mexico's Banco Nacional de Obras y Servicios Publicos, which is financed through a combination of bonds, government sources, loan repayments, and multilateral agencies such as the IBRD and Inter-American Development Bank. The Mexican bank makes advances to federal agencies and to states, municipalities, and their agencies through several lines of credit—for example, a water supply and sewerage investment fund lending to states and municipalities; a regional urban investment fund; a national program for urban development targeted to small municipalities; and a higher-interest program for urban development used mainly by the largest cities. Interest rates are positive in real terms and above the cost of capital, but loans to smaller municipalities have lower rates than loans to large municipalities. The Mexican bank's overall financial situation is strong; it is responsible for loan appraisal and supervision and has authority to issue bonds earmarked for individual sectors.

Costs of Private Financing

6.19 Costs associated with private financing include the diversion of domestic resources to a lower-priority activity—to the extent that project selection criteria are distorted by the quest for leverage—to bring in the foreign investment and make the project work. There are other costs. Necessary ancillary investments by the government can often be significant. Private investors prefer to invest in existing high-demand areas instead of extending services to new, unserved areas—because revenue is surer—even though doing so may be against the best interests of the city or region. In addition, it is not clear that privately funded construction costs less than public alternatives, especially for projects that are not bid competitively. Foreign owners and creditors may also seek compensation for the inherent riskiness of these projects and for the high transaction costs in their preparation and negotiation. Given these considerations, investors in BOTs and BOT-like projects—concessions or development gains—might be expected to demand high rates of return. Although the sparse information at hand suggests that financial rates of return are not higher than in the OECD countries, rates are certainly higher than those sought by public sector managers.10/ The important point is the rate of return on equity—which is usually much higher because of leverage. But there is little information about this aspect.

Inventory of Privately Financed Projects

6.20 An analysis of private financing of infrastructure in the developing world (Tables A6.1 and A6.2)—by country and by infrastructure type—points up that by early 1991 fewer than ten BOTs had begun operating, although more than twice that number had been initiated or were in advanced planning. Power generation and transport are by far the most common types of infrastructure financed through BOTs. Most projects are concentrated in a few Asian countries. Concessions, on the other hand, are established and more widespread. They are found typically in French-speaking Africa and in the water sector, but in Latin America they are all power utilities. Development gain is just being introduced in developing countries—and has been proposed only for mass transit.

6.21 Self-help is a common way of financing small-scale infrastructure projects—in all sectors—throughout the developing world, often using cooperatives, which are especially common in Latin America. Bonds—in Asia and Latin America—are used to finance major investments in all infrastructure types. Infrastructure banks are found primarily in Latin America, where they typically lend for urban infrastructure investment, such as roads and water and sewerage.

10/ Financial internal rates of return vary for transport projects in the OECD countries. The Chesapeake Bridge in the United States yielded about 5 percent, the Mont Blanc Tunnel 17 percent, the Channel Tunnel (before recent cost overruns) 17 to 19 percent, and the Paris-Cologne fast train (TGV) 6 to 11 percent. The Hong Kong Metro had negative returns, while the last two Hong Kong tunnels were expected to yield 14 to 16 percent (Havlicek 1990). Projected rates of return of BOTs in developing countries appear to be higher. The Hab River Power project in Pakistan is earning 18 to 23 percent; the Gazi Power Plant in Turkey, 16 percent; Malaysia's Labuan Water Supply Project 18 to 20 percent; and Bangkok's Second Stage Expressway, 21 percent (Augenblick and Custer 1989).

Potential Costs and Benefits

6.22 Private investment in infrastructure generally offers four potential benefits: reduced risk for the public sector; greater efficiency and innovation in construction and operation and reduced burdens on public sector management (when investment is linked to private ownership and operation); additional funding for investment; and positive externalities—tangible and intangible. Having a greater private sector presence in the economy leads to a better image in the world investment community, more responsive and appropriate public policy, improved management attitudes and practices, and greater exposure to outside ideas and market developments. Bond financing, with no direct influence on system design or operation, could achieve the latter two benefits. The character and magnitude of a self-help project's benefits may be somewhat different.

6.23 ***Additionality***. Additionality is usually defined as the net increase in investment resources made available to the economy as a result of private investment in infrastructure. Resources for investment come from domestic savings—private and governmental—and foreign capital inflows. A project must increase the total of these resources to be additional. The question of the existence and level of additionality is contentious and complicated. Skepticism about these benefits appears widespread among Bank staff, although no systematic analysis has been done.

6.24 The extent of additionality depends on the pattern of financing—whether foreign or domestic financing, using debt or equity. *Foreign equity* components are clearly additional. The foreign equity providers engaged in a BOT or BOT-like project are far more likely to invest elsewhere than in the host country in the absence of the project. The inflow is a net increment to national savings—and there is no reason why other savings, foreign or domestic, should fall as a result. The value of the equity inflow might be reduced if, as some practitioners suggest, project proposers raise the prices of project inputs to offset the cost of their "forced" equity participation. But exactly how this would happen in a competitive situation is not clear and, in any case, such considerations should be reflected in the project's rate of return. The "deduction" from equity is thus not likely to be significant.11/

6.25 *Foreign debt* financing is probably largely additional in most countries. The two credit sources are commercial banks and international or bilateral aid or export credit guarantee agencies. One basic question is whether these institutions have fixed credit ceilings—risk limits—for the borrowing country and whether, in the absence of the project in question, they would lend to that limit anyway. Neither is likely. Unless countries are heavily indebted, commercial banks would probably be ready to lend to a BOT or BOT-like project with a special security package, in countries where they would not otherwise lend at all. Even if individual commercial banks have risk limits, the BOT or BOT-like project can engage a larger number of banks in the financing—thus expanding total credit availability. The aid and export credit agencies are likely to find private-public ventures attractive lending opportunities and thus expand their country lending ceilings. The other big question about additionality of foreign debt financing is whether a BOT or BOT-like project crowds out other investments because of the local resources it absorbs. Whether crowding out occurs

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11/ In principle, it is necessary also to look at this issue of additionality in the long term, when the net effect will depend on future repartition of equity, dividends, tied contracts, and so on.

depends on the project's financing pattern and the economy's flexibility. The need for government guarantees might reduce the extent of any additionality by subtracting from the government's ability to borrow for other purposes.

6.26 A project drawing on private *domestic equity* is additional only if it attracts flight capital or raises interest rates and induces new savings. Financing using *domestic debt* is generally nonadditional and probably distorts investment allocation—as government diverts resources from possibly higher-productivity uses to benefit from the leverage of the BOT or BOT-like project. For bonds domestically issued and held, the attributes of both domestic debt and equity hold. There is additionality to the extent that flight capital is repatriated or interest rates and savings rise, and there are allocative distortions.

6.27 Because of the sparsity of experience and evidence, it is hard to see a typical financing package. Foreign equity investment, however, is present in all BOT or BOT-like projects, generally at 10 to 30 percent of total investment. Foreign commercial bank credits are invariably a major element, usually carrying an export credit guarantee. Host government equity participation does not seem to be a major element compared with contributions using subordinated debt and guarantees. Thus, the additionality of most BOTs and BOT-like projects is probably rarely less than 25 percent of the total project cost and is likely to be substantially higher.

6.28 ***Reduced government risk.*** A central feature of BOTs or BOT-like projects is limited-recourse financing, in which owners and creditors receive no government guarantees—but can lay claim only on the project company's assets and revenues. To the extent that project risks are borne by private financiers, government risk is reduced. But government risks are usually reduced by no more than one-third. In the typical case, there are guarantees of minimum traffic volume or take-or-pay arrangements, as well as government guarantees on project debt. The Hong Kong East Harbor Crossing project, discussed above, is rare in that the owners bear substantial risk.

6.29 ***Efficiency.*** Efficiency benefits from private infrastructure investment can come in either lower-cost, more innovative design and construction of the physical plant or in more cost-conscious, market-sensitive, and dynamic management. These benefits, however, might be partly offset by the preclusion of construction in stages and the need to introduce tolls that add to construction and operating costs.

6.30 Doubts exist about the magnitude of both efficiency benefits. The first benefit is most likely to be significant for a BOT or BOT-like project for which bidding is competitive and specifications are general. But, the high negotiating costs, the endemic uncertainties, and the nature of BOTs—with their unsolicited proposals and frequent informal commitments at early stages—will always make competitive bidding difficult or ineffective. So efficiency gains at the design and construction stage may not be substantial.

6.31 The gains from more effective management could be greater, because operating inefficiencies are usually a greater source of resource waste than are bad design or excessive construction costs. But inefficient operations often result less from bad management than from inappropriate macroeconomic policies, weak regulatory systems, or crippling institutional arrangements. And at least some of the efficiency gains from private ownership and management

could be obtained by contracting or leasing to private management. In principle, these two possibilities lower the potential net benefits from reduced burdens on management.

6.32 ***Positive externalities.*** Successful adoption of a program drawing on private investment for infrastructure will almost surely bring many positive external effects, although their magnitude is uncertain. The reputation of a country and the worldwide perception of its investment climate will almost certainly improve; openness to such investment is a strong signal of commitment to private investment in general. Local capital markets may be strengthened. Even the process of negotiation can have positive effects by making explicit the nature and magnitude of the risks and uncertainties involved in the project and by making clearer where the regulatory system blocks investment and frustrates entrepreneurship.

6.33 The process can leave government negotiators and the economy better prepared for dealing with private—especially foreign—investors. A facility's managers can be expected to become articulate advocates of prudent macroeconomic management, regulatory reform, full-cost pricing of services, and better maintenance of ancillary infrastructure. The project thus will have demonstration effects for management of other firms—state-owned or other—and provide a new kind of window to the world. And, finally, such a project will bring a new form of liberalizing yeast to the economy. These positive external efforts may be the most important of all the potential benefits.

Potential for Use

6.34 Some types of private investment have more promise than others and the potential is greater in some developing countries than in others. For many reasons, the classic BOT—a major green field investment in roads, tunnels, or power stations—is unlikely to spread much beyond the few faster-growing, highly market-oriented economies in Asia where it now can be found. Concessions, self-help investments, and bond flotation are more widely applicable.

6.35 The slow implementation of BOTs partly reflects their newness but also indicates more fundamental obstacles. First, few countries have regulatory systems well-developed enough that definitions of rights and obligations of private investors and the state can be straightforward. Contract negotiations generally occur in a black box with an abundance of gaps and ambiguities. And, the BOT arrangement is still so rare that replicable models do not exist. Each country has a unique environment, partly because of the unique character of each deal, and partly because details are often secret. Changes of government can further complicate matters. So transaction costs in these projects are relatively large.

6.36 And—because infrastructure remains highly vulnerable to government interference—few private investors in infrastructure appear willing to bear the kinds of risk that they accept in other investments. For BOTs, private investors tend to require a higher return on their capital than most governments find acceptable, and the implicit costs to government can mount as ancillary investments are required—access roads, new transmission lines, and so on. Thus the poorest countries are not likely to be able to attract BOT investments.

6.37 Concessions have a better track record than classic BOTs and are found throughout developing countries. Unlike BOTs, concessions have had well-worn models for many years.

Regulations to make them work are already in place in at least a few countries, making the path clearer for interested investors and governments. In addition, unlike BOTs, concessions do not usually involve starting from scratch but, instead, involve private takeover of an existing public utility. New investment is incremental. Compared with BOTs, then, the concessions are inherently simple and less risky. The ROT project in the Philippines is a variation on this approach.

6.38 Self-help projects, because of their smaller scale and independence from government oversight will remain the most common type of privately built and managed infrastructure. Their smaller scale typically limits their effects, but—as seen in private power generation in Indonesia—there can be notable exceptions. Often the most positive support government can offer is the removal of regulations that oppose establishment or expansion of systems. Bans on the sale of self-generated power to utilities are one of the more common obstacles to expansion.

6.39 Bond financing of utilities or roads has successfully mobilized available savings in many countries, although not in Africa. External bond financing requires a functioning capital market and an attractive investment. In countries with limited individual savings and a limited capital market, pension funds can provide a valuable source of domestic capital.

6.40 For the last several years, private investment in infrastructure has been identified—in the investment community, the Bank and the popular press—with BOTs, but the BOT in its classic form is perhaps the least promising instrument reviewed here, at least for the developing countries that most need private investment in infrastructure. And while analytic and policy attention—in and out of the Bank—has been heavily focused on BOTs, the special needs of the poorest countries in this area are inadequately served.

Annex 6.1
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Privately Financed Infrastructure by Country

REGION/Country/Infrastructure Type	BOT	Concession	Development Gain	Self Help	Bonds
AFRICA					
Chad					
Utility		P			
Côte D'Ivoire					
Abidjan Water System		O			
Ghana					
Rural Roads				O	
Madagascar					
Water Utility		O			
Power Utility		O			
Telecommunications		O			
Malawi					
Rural Roads				O	
Nigeria					
Self-generation				O	
Tube Wells				O	
Sao Tome and Principe					
Sao Tome Utility		P			
ASIA					
Bangladesh					
Electricity Cooperatives				O	
Water Cooperatives				O	
China					
600 MW Coal-fired Power Plant	P				
700 MW Coal-fired Power Plant	O				
Minihydro Projects				O	
Water Utility		O			
Hong Kong					
Cross Harbor Tunnel	O				
E. Harbor Crossing	O				
Tate's Cairn Crossing	I				
Lantau Fixed Crossing	P				
W. Harbor Crossing	P				
Mass Transit Railway			O		
Power Utility		O			
Water Utility		O			
India					
Telecommunications					O
Railways					O
Bombay Power		O			
Power					P
Electricity Cooperatives				O	
Indonesia					
North-South Link	O				
Other Toll Roads	P				
Other Toll Roads					P
Cogenerated Power				O	
Electricity Cooperatives				O	

Key: O = Operational **I = Initiated** **P = Planned**

Privately Financed Infrastructure by Country

REGION/Country/Infrastructure Type	BOT	Concession	Develop-ment Gain	Self Help	Bonds
ASIA (continued)					
Korea					O
Taegu City Roads					
Macau					
Water Supply		O			
Malaysia					
Labuan Water		O			
Labuan Power Transmission	I				
N. Kelang Straits Road	O				
KL Kepong Interchange	O				
North-South Expressway	P				
Kuala Lumpur Interchange	P				
Nepal					
Suspended Bridges				O	
Philippines					
Manila Electric Light Co.		O			
Private Power Dist. Cos.	O				
Manila Waterworks & Sewage					I
200 MW Gas Turbine Plant	O				
700 MW Coal-fired Power	I				
300 MW Coal-fired Plant	I				
Container Port	I				
117 Electricity Cooperatives				O	
Telecommunications Cooperatives				O	
Water Cooperatives				O	
Thailand					
2nd Stage Expressway	I				
Bangkok Mass Transit	P		P		
Other Road Systems	P				
Cogeneration				O	
Vietnam					
Electricity Cooperatives				O	
EUROPE, THE MID-EAST, AND NORTH AFRICA					O
Jordan					
Urban Infrastructure					
Morocco					
Water Supply		O			
Oman					
100 MW Power	I				
Pakistan					
Hab River Power	I				
Karachi Mass Transit	P				
Water and Power					O
Tube Wells				O	
Turkey					
1000 MW Aliaga Plant	I				
200 MW Karactepe Plant	I				
Gazi Power Plant	P				
Cogeneration				O	

Key: O = Operational **I = Initiated** **P = Planned**

Annex 6.1
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Privately Financed Infrastructure by Country

REGION/Country/Infrastructure Type	BOT	Concession	Develop-ment Gain	Self Help	Bonds
EUROPE, THE MID-EAST, AND NORTH AFRICA (continued)					
Yemen					
Rural Roads				O	
LATIN AMERICA AND THE CARIBBEAN					
Argentina					
Electric Power		O			
Water Cooperatives				O	
Barbados					
Light and Power Company		O			
Bolivia					
LaPaz Power		O			
Water Cooperatives				O	
Electricity Cooperatives				O	
Telecommunications Cooperatives				O	
Brazil					
ELECTROBRAS Utility					O
Electricity Cooperatives				O	
Telecommunic. Cooperatives				O	
Small Local Infras.					O
Chile					
Santiago Water		O			
Sewerage	P				
Electricity Cooperatives				O	
Water Cooperatives				O	
Colombia					
Sewerage	P				
Urban Infrastructure			O		O
Urban Infrastructure					O
Electric Power				O	
Electricity Cooperatives					
Costa Rica					
Cogeneration				I	
Electricity Cooperatives				O	
Dominican Republic					
40 MW Power Generator	O				
Ecuador					
Guayaquil Private Power Co.		O			
Electricity Cooperatives				O	
Mexico					
Small Urban Infras.					O
Nicaragua					
Electricity Cooperatives				O	

Key: O = Operational **I = Initiated** **P = Planned**

Privately Financed Infrastructure by Infrastructure Type

INFRASTRUCTURE TYPE/ Region/Country	BOT	Concession	Develop-ment Gain	Self Help	Bonds
POWER - UTILITY					
Africa					
Madagascar		O			
Asia					
Bangladesh				O	
Hong Kong		O			
India		O			
Indonesia				O	
Philippines		O			
	O				
				O	
Vietnam				O	
Europe, Mid-East, N. Africa					
Jordan					O
Pakistan					O
Latin America & Caribbean					
Argentina		O			
Barbados		O			
Bolivia		O			
				O	
Brazil					O
				O	
					O
Chile				O	
Colombia			O		O
Costa Rica				O	
Ecuador		O			
				O	
Mexico					O
Nicaragua				O	
POWER - GENERATION					
Africa				O	
Nigeria					
Asia					
China	P				
	O				
				O	
India					P
				O	
Indonesia					
Malaysia	I				
Philippines	O				
	I				
	I				
Thailand				O	
Europe, Mid-East, N. Africa					
Oman	I				
Pakistan	I				
Turkey	I				
	I				
	P				
				O	

Key: **O = Operational** **I = Initiated** **P = Planned**

Annex 6.1
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Privately Financed Infrastructure by Infrastructure Type

INFRASTRUCTURE TYPE/ Region/Country	BOT	Concession	Development Gain	Self Help	Bonds
POWER - GENERATION (continued)					
					O
Latin America & Caribbean					
Colombia					
Costa Rica				I	
Dominican Republic	O				
TRANSPORT					
Africa					
Ghana				O	
Malawi				O	
Asia					
Hong Kong	O				
	O				
	I				
	P				
	P				
			I		
India					O
Indonesia	O				
	P				
					O
Korea					O
Malaysia	O				
	O				
	P				
	P				
				O	
Nepal	I				
Philippines	I				
Thailand	P		P		
	P				
Europe, Mid-East, N. Africa					
Jordan					O
Pakistan	P				
Yemen				O	
Latin America & Caribbean					
Argentina	O				
Brazil					O
Colombia			O		
					O
Mexico					O
WATER & SEWERAGE					
Africa					
Cote d'Ivoire		O			
Madagascar		O			
Asia					
Bangladesh				O	
China		O			
Hong Kong		O			
Macau		O			
Malaysia		O			
Philippines					I
				O	

Key: O = Operational **I = Initiated** **P = Planned**

Privately Financed Infrastructure by Infrastructure Type

INFRASTRUCTURE TYPE/ Region/Country	BOT	Concession	Develop-ment Gain	Self Help	Bonds
WATER & SEWERAGE (continued)					
Europe, Mid-East, N. Africa					
Jordan					O
Morocco		O			
Pakistan					O
Latin America & Caribbean					
Argentina				O	
Brazil					O
Bolivia				O	
Chile		O			
	P				
				O	
Colombia	P				
			O		
					O
TELECOMMUNICATIONS					
Africa					
Madagascar		O			
Asia					
India					O
Philippines				O	
Latin America & Caribbean					
Bolivia				O	
Brazil				O	
IRRIGATION					
Africa					
Nigeria				O	
Europe, Mid-East, N. Africa					
Pakistan				O	

Key: **O = Operational** **I = Initiated** **P = Planned**

Chapter 7

Demand Orientation through Competition Surrogates: Decentralization and Voice

7.1 The previous two chapters concluded that competitive markets and the private sector have a larger role to play in enhancing the productivity and demand orientation of infrastructure activities than is usually acknowledged. However, the intrinsic nature of some infrastructure—many highways, urban roads, major water works, and power distribution—requires that they continue to be provided as public goods by the public sector, usually as monopolies. The extra accountability and demand orientation that automatically are part of a competitive market are unavailable for such activities. Those effects will have to be simulated through competition surrogates, a second-best approach.

7.2 The most promising surrogates for infrastructure services appear to be administrative decentralization and voice—active participation of clients, users, or beneficiaries in the running or management of a service. There is no reason, of course, why markets and competition surrogates cannot be used simultaneously. Because many forms of infrastructure will continue to operate as regulated monopolies—or under monopolistic conditions—these competition surrogates can be used to achieve stronger market discipline and demand orientation. Clients' voice regarding private monopolies, for example, could ensure better service and lower cost—with clients reinforcing the role of regulators. Markets can be decentralized to achieve closer local participation.12/

7.3 Competition surrogates are less powerful than competitive markets in enhancing productivity and a demand orientation. As a consequence, those services that must remain as monopolies—public or private—can probably never be expected to achieve the operational performance attained in competitive markets. There is no complete solution to this problem and countries should learn to face that fact and act accordingly.

Decentralization

7.4 The option of decentralization offers in principle an effective way to achieve higher productivity and a demand orientation. This avenue, however, should be approached only when preconditions for success are in place. Local administrative units providing infrastructure traditionally have been weak field units of central agencies, dependent on central administrations for decisionmaking and financial resources. Increasing dissatisfaction with the inefficiency and unresponsiveness of central governments has fueled a search—often half-hearted—for decentralized alternatives. One result has been a tendency to transfer responsibility without careful consideration

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12/ Several aspects of decentralization and voice are not reviewed in this paper—for example—the role of NGOs. See Paul and Israel 1991.

of local or regional authority and absorptive capacity. But because public-sector decentralization is becoming the norm—particularly in East Asia, Eastern Europe, and Latin America—a clear position is needed on the subject.

7.5 Central governments have been criticized for inefficiencies resulting from reduced opportunities for local initiatives; inaccurate information flows to decisionmakers; the reduction of civil servant responsiveness to citizens' demands, because of limited incentives for central government ministries to consider citizens their clientele; and imperfect controls over civil service personnel. Other criticisms cover resource allocations that favor central governments over field units; confusion of responsibilities and accountability, resulting in weak incentives at all levels; tendencies to be more concerned with glamorous and overly elaborate—often capital-intensive—construction and infrastructure projects at the expense of routine maintenance; and citizens' perception of infrastructure provided by the central government as free because of the lack of connectedness between provision and consumption (Thompson, Connerley, and Wunsch 1986). Other studies point to additional problems of overcentralization: incomplete financial independence, weak local training and professional competence, and inadequate technical support for operations.

7.6 ***Administrative decentralization.*** Administrative decentralization involves the transfer of responsibilities for financing, allocating, planning, and managing resources from central government to subordinate units.13/ There are three types of administrative decentralization, which could coexist in one organization for different functions:

- *Deconcentration* involves the shifting of functions to local agents while retaining decisionmaking and financial control centrally. Authority, responsibility, and accountability are retained centrally.

- *Delegation*, a more comprehensive form of decentralization, involves the transfer of responsibility for most decisionmaking, yet the retention of some authority and accountability in the central government.

- *Devolution* involves the fuller transfer of authority for decisionmaking, responsibility for activities, and accountability mechanisms to subnational units, usually involving the granting of corporate status to those units.

7.7 Decentralization is one of the institutional reforms that may have the highest potential for failure and distortion—for example, through conflicts between levels of responsibility and authority, or responsibility and control. The weaker a country's institutional structures, the wider the difference in institutional strength between central and local agencies and the greater the risks

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13/ Decentralization can take three other forms. *Political* decentralization involves the expansion of citizen involvement in decisionmaking, usually through larger representation or beneficiary participation. *Spatial* decentralization involves the diffusion of activities across regions to build local or regional capacity. *Market* decentralization involves the use of market mechanisms to provide infrastructure by relying on the revealed preferences of individual consumers. See Rondinelli 1990; Rondinelli and Nellis 1986; and Silverman 1990.

of decentralization. Paradoxically, the countries with agencies most in need of decentralization are the least likely to successfully decentralize. Deciding about the most reasonable degree and form of decentralization requires estimating the likely negative effects in a specific institutional and political context.

7.8 In cases of infrastructure activities where there is considerable homogeneity, capital intensity, need for central political commitment, or limited local capacity, central control may be more appropriate. In some countries, power generation or water resource development requires a national strategy for coordinating choices and providing for initial capacity. But, where tasks are highly specific and the principal concern is with technical efficiency or feedback from clients, some form of decentralization may be more appropriate. Specificity in tasks and clear, fair rules and rights may not only call for decentralized solutions, but also offer more sustainable outcomes. Providing clear, fair rules, rights and priorities in irrigation projects—for example, rules for allocating water among farmers, the responsibilities of beneficiaries for operation and maintenance, penalties for noncompliance—during design can facilitate sustainable program development. At the same time, functional specialization at the different levels—for example, on planning, design, construction, operations and maintenance, and regulatory activities—is facilitated by a clear organization of rules of operation and staffing.

7.9 ***Conflicts of responsibility and authority.*** Decentralization and public enterprise reform are closely parallel: key to both are the interactions between local or decentralized agencies—or public enterprises—and the central government agencies that define and monitor the decentralized agencies' operating rules. Experience shows that a large share of the factors determining the performance of these local and decentralized agencies are controlled by the central government. One severe limitation of infrastructure decentralization has been the gap between responsibility and authority or capacity. Transfers of responsibility without a corresponding transfer of both authority and resources have often spelled disaster, generating distrust at the local levels that receive added responsibilities. Central governments—often uncommitted to granting autonomy—maintain control over key appointments, the budget, procurement, revenue generated and labor regulations, thus seriously hindering the capacities of local agencies to operate effectively.

7.10 Efforts to clarify levels of responsibility and authority are evident in the Senegal Debi-Lampsar Irrigation project. SAED, a state corporation, was created to plan and develop irrigation in the river basin. The central government, however, required compliance with complicated financial and administrative procedures—for example, on bidding and expenditures—and kept central accounts. Delays, inefficiency, and the deterioration of SAED's finances resulted. To avoid these problems during implementation, the government agreed to regular budget transfers to SAED and eased requirements on prior approval of expenditures. Mutual financial and operational responsibilities of SAED and the government were defined more clearly. In addition, efforts were made to link SAED activities to beneficiaries: decentralization was intended to give farmers greater autonomy through separate project management teams with technical and administrative independence.

7.11 Another serious concern in a decentralization program is the coordination of legal and administrative procedures affecting different units. In the Brazilian Southern States Water Supply and Sewerage Project, the borrower was the National Housing Bank, the central institution and main source of investment funds—allocating resources among states, setting goals and priorities, and

supervising and assisting as necessary. Start-up delays resulted from confusion and poor coordination in the effort to shift responsibilities to the state level. At all state water companies, procurement was a problem because of doubts about the applicability of World Bank guidelines. The National Housing Bank had not issued guidelines because several state and national regulations conflicted with the World Bank's directives. Furthermore the World Bank's subproject selection and approval criteria did not conform to National Housing Bank project preparation guidelines which the state water companies had to follow. In fact, subproject selection criteria varied with each of the five existing World Bank loans to The National Housing Bank. By 1986, the National Housing Bank ceased to exist—its functions were subsumed in yet another central governmental body—and confusion about guidelines and authority persisted.

7.12 Dramatic and sudden decentralization programs have often created more coordination problems than they have solved. In the Upper Volta Rural Roads project in Ghana rapid decentralization compounded serious problems of local capacity and inefficiency. The initial intent was to strengthen the central Secondary Roads Maintenance Service, but during project implementation responsibility for maintenance operations was shifted to regional directorates which could not accommodate the increased tasks. A series of projects gradually shifting responsibility may often be more appropriate.

7.13 One way to analyze the potential for decentralization is to use the criteria of excludability and subtractability noted in Chapter 5. Where both criteria are high, the logic of decentralization obtains. Where one or both of these do not apply, alternatives to full decentralization may be more appropriate. For example, in water supply and sanitation most studies point to the efficiency of a three-tiered combination of centralization and decentralization. Excludability applies to this sector—especially in the urban context—making decentralization feasible. But the natural monopoly of water supply and sanitation suggests a need to allocate responsibilities among different levels. At the *national* level, an agency should be responsible for finance, long-term planning, standard-setting, coordination of training, advice and support, procurement of imported parts and technical assistance. At the *regional* level—for example, state or provincial governments—an agency should be responsible for the implementation of nationally approved standards and regulations, supervision and support of local systems, and planning and training for local management and technical staff. And entities at the *local* level—for example, municipal agencies or community organizations—should be responsible for management, collection of fees, monitoring of use, operation and maintenance of the local system, and local budgetary planning (United Nations 1990).

7.14 A similar division of responsibility and accountability seems appropriate for other infrastructure activities where natural monopoly conditions exist, reasonable levels of excludability and subtractability are evident, responsiveness to local clients is needed, and it is possible to enforce linkages between use and payment—for example, for power transmission and distribution.14/ In other cases where monopoly conditions are not as prevalent, but where excludability and

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14/ This decentralization would create difficulties for rural electrification, however, which generally operates at a loss, because mass-subsidization would not be possible in a decentralized scheme.

subtractability do exist, an emphasis on lower levels of administration may be more appropriate. Such would be the case for most transport, irrigation, and rural water systems.

7.15 As indicated, the discussion of these alternatives has to be in the context of the relative strengths of institutions at different levels. Local institutions often are weaker than central ones, and successful decentralization requires a major local institutional buildup that might not be feasible in the short term. The political context is also crucial: a weak local institution is more likely to fall under the influence of local pressure groups than become responsive to legitimate local needs.

7.16 ***Conflicts of responsibility and control.*** Failure to link responsibility and effective control limits the ability of organizations to operate on a commercial basis, providing few incentives for cost recovery. In Benin, the telecommunications public enterprise, the OPTB, has since 1984 been subject to direct control by the Ministry of Information and Communications. Financial transfers from the central government have occurred without effective autonomy and accountability at the enterprise level. The result has been limited incentive to improve operational efficiency, low collection rates, and insufficient cost recovery. Instead of being competitive and self-financing, the OPTB has drawn on the central treasury to cover deficits. The recent introduction of greater operational autonomy and a contract plan that establishes clear rules for dialogue and negotiation may provide a sound basis for improving performance—although problems of full financial control still remain.

7.17 A key aspect of decentralization is financial management and control. Although full cost recovery is always advocated, there are practical difficulties. An example is the Xiamen Port Project in China. In the 1984 port reform, the Ministry of Communications began to encourage autonomy and decentralization. Reforms included self-financing of port operations, investments to be funded by internal cash generation, and increasing competition among ports. Before these reforms, the Ministry of Communications set tariffs, allocated cargo, provided grant financing for investments, covered any deficits, and collected most surpluses. As a result, there were few incentives for any port to become efficient. Now only a portion of the cargo is allocated, tariffs for unallocated cargo are allowed to be set competitively within a narrow range, and profits are retained by ports and subject to taxation. Decentralization has become effective.

7.18 The failure to provide financial and decisionmaking autonomy is particularly critical in sectors having reasonably specific, highly technical, and self-contained infrastructure activities. In these cases, there is little need for central governmental control. Such is the case in telecommunications. In the Jordan Telecommunications Project problems of autonomy troubled the agency and the project from the outset. Authority for public telecommunications and postal services is vested in the Ministry of Communications. TCC is a semiautonomous public agency in charge of providing and operating domestic and international telecommunications services. TCC has a monopoly, but its institutional capacity has not kept up with the expansion and improvement of the network—and, for all practical purposes, it is operated as a central government agency, without autonomy. In such a case, the central government motivation might be direct appropriation of the surpluses generated by an agency.

7.19 Another approach for determining appropriate levels of decentralization in infrastructure relates to specific functional activities (Silverman 1990). Retaining central roles for policy formulation and overall planning, but decentralizing operations and maintenance in specific and technically routine activities, may prove most effective in weak states. For example, the design of the Seventh Madagascar Highway Project demonstrates concern for the appropriate division of responsibilities. Formerly, all activities were centralized in the Ministry of Transportation's headquarters in the capital—including the designing of road maintenance operations, the dispatching of brigades, and the instructing of the regions—which led to inefficient, inflexible road maintenance operations with a lack of adaptability and continuity. Decentralization of road maintenance while retaining central administrative control over policy planning and implementation, and the monitoring of regional programs through performance accounting systems, allowed for a reasonable distribution of responsibility and accountability.

7.20 The World Bank has focused attention more recently on the use of contractual arrangements to introduce competition surrogates—in particular contract plans or negotiated performance agreements between owners—the central government—and managers of public enterprises (Nellis 1989). Although contract plans vary greatly, some generalizations are apparent. First, contract plans may have been oversold as a means for resolving financial and efficiency dilemmas of state-owned enterprises. Although there are some clear potential benefits—such as improved accountability, consistency in supplies, better personnel management and closer relationships between rate structures and costs—performance has not improved significantly. Many of the dilemmas are because contract plans are not true contractual relationships with autonomy of financial decisionmaking and enforceability for noncompliance—particularly noncompliance by the central government. Fairness and clarity in rules and relationships have not been achieved—perhaps as a result of limited government commitment to the transfer of power implicit in the contract. Political will and the institutional capacity in central government agencies to supervise and monitor behavior are needed. Still, some of these generalizations might be premature and the positive effects might take longer to materialize. A more systematic dialogue than in the past between public enterprises and central government agencies over a number of years might bear fruit.

Voice

7.21 Market-oriented and administrative changes are necessary to enhance a demand orientation in infrastructure services—but not always sufficient. Voice—participation—of clients, users, or beneficiaries is particularly relevant for infrastructure, given the relatively limited range of competitive markets for many subsectors and the often problematic effects of administrative solutions. And sustainable programs require a sense of ownership, with services responsive to beneficiaries' or clients' felt needs. In extreme cases, such as highways, in which there is no direct contact between users and suppliers and governments operate the infrastructure as a local monopoly, how to bring voice as an additional form of demand orientation or accountability is a major issue. The closer the connectedness between client and service, the greater the probability that concern for sustainable service will be expressed. Issues of appropriate technological level, of community participation, of willingness to pay all revolve around this sense of ownership and voice. In the absence of voice, beneficiaries—such as farmers in irrigation projects—may choose to exit. In project after project, the role of clients in infrastructure operation and maintenance has been a difficult issue. Yet the establishment of mechanisms for voice has been the key to success for

several projects.15/ The higher the level of market failure, the greater the importance of developing voice.

7.22 Voice, Samuel Paul says, is "the degree to which [users] can influence the final outcome of a service through some form of participation or articulation of protest/feedback" (Paul 1991a, p. 13). Voice can be expressed in a variety of forms, depending on the country and the circumstances—for example, in user or client associations, nongovernmental organizations, cooperatives, political groups, or direct intervention in the management of services. As distinct from "exit"—an economic action that can be taken independently by an individual—voice usually requires some form of collective action. Individual pressure is seldom effective, particularly for the poorest segments of the population. Voice has a cost, and could be assessed by the participants as a cost-benefit calculation. In principle, the more competitive a market, the less desirable is the voice option relative to the purely economic one of exiting the market. However, voice is effective only if people feel that they will be heard, that they do "own" or substantially influence the operation.

7.23 The potential for voice depends on several factors. Some are fairly obvious, such as the relative importance of a service to a client, and the public's income, education, and cultural characteristics. But there are other factors, such as legal and institutional barriers, closely related to the political environment; cultural mores (for example, availability of public hearings); informational asymmetries, in the sense that suppliers often have more information than the clients; and the level of differentiation in the service. The less differentiated a service, the stronger is the voice option, because all users—weak and strong—have a stake in it.

7.24 Paul's analysis helps to tentatively classify infrastructure subsectors according to their potential for exit and voice (Table 7.1). Such a scheme does not reflect the actual continuum, but is operationally useful. Most subsectors offer a relatively high potential for the use of voice. The assumption is that in cases where the potential for exit also is high—dissatisfied users will exit (quadrant 4). The interesting ones are those sectors in which exit is less feasible but the voice option has a high potential (quadrant 2). The implicit assumption is that urban environments are more suitable for exercising voice than are rural ones, because of the generally better economic and educational conditions of the population. The mechanism that is preferable for exercising the voice option depends on each subsector.

7.25 The difficult cases are those for which the potentials for exit and voice are both low (quadrant 1). This difficulty is reflected in the many unsuccessful efforts to build up a voice option in interurban highways, waste treatment, or major irrigation works. Paul's analysis confirms the importance of finding working alternatives for developing voice and participation in those subsectors. The development of voice and exit appears to be closely linked to the extension of user charges for these services. The more developed these charge systems, the higher the chances of building up effective voice and participation options. It is interesting that quadrant 3, the high exit and low voice alternative, is empty. If exit is an option, a weak voice is probably irrelevant.

15/ This is not the place to review the extensive literature on community participation, beneficiary roles, and "listening to the people." For further information,, see Paul 1991; Korten 1980; Salmen 1987; Uphoff 1985; and Cernea 1991.

Table 7.1
Infrastructure Activities, Potential for Exit and Voice

		VOICE	
		Low	**High**
EXIT	**Low**	rural roads rural water supply major water storage waste treatment major irrigation systems hydro power generation interurban roads waterways 1	urban roads hydro power generation large-scale irrigation airports public ports telecommunications small irrigation systems power distribution thermal power generation 2
	High	3	4 urban transport road transport rail passenger rail freight

Source: Based on analyses by Samuel Paul (1991a).

7.26 The relevance of client participation also can be considered in terms of the distinctions between public and private goods. With public goods, the need to enhance a demand orientation by including clients, users, or beneficiaries becomes paramount. In these cases, fear of lack of accountability and the need for explicit incentives for suppliers become most evident. In rural roads, the need for involvement, for voice to be institutionalized, is critical at all phases of planning. Planning inputs tend to come from several agencies and from the community served; in construction, there is a need to keep costs down, putting labor-intensive techniques at a premium in most cases; during operations and maintenance, there is a need to develop community capabilities with effective technical assistance and financial support from the central government (Cook 1985). One crucial

area for encouraging voice and local participation is in maintenance. Many projects—especially rural roads and irrigation—are built on the assumption that community maintenance will occur, yet it rarely does. The track record of authentic community participation in design, planning, and construction appears weak (Box 7.1). Failure to incorporate beneficiaries affects performance in several ways. For example, there is a top-down mentality that pervades most public works departments which may require bureaucratic reorientation. Over-standardization and program complexity in administrative procedures and standards, bidding procedures, or disbursements may discourage participation.

7.27 A wider use of voice is encouraged by treating project design as a learning process instead of a blueprint. The learning-process approach helps reduce discontinuities between planning and implementation, because implementation often requires creative adaptation. For example, the Nepal Second Mahakali Irrigation Project includes continuing support for pilot farms established under the first project, which provide training for extension workers and farmers. A project coordination committee is to be formed to assist implementation and operation. The committee will consist of the project manager, representatives from the district level (Panchayat), and a farmer representative from secondary canal operations. The major function at this level is communication among farmers and project staff. Farmers would participate through the committee in project decisions—which should help them identify with the project, develop a sense of ownership, and commit to operations and maintenance tasks. This committee is to continue to operate after construction. The project should transform informal farmer groups into formal farmer irrigation associations discussing project details, negotiating participation and cost-sharing arrangements with farmer groups, and training and preparing groups for operations and maintenance of completed subprojects.

7.28 Other options for ensuring voice and participation are lengthman systems in which, for example, each beneficiary is assigned part of a road network; developing local contractor capabilities; self-help organized by local leaders; and use of nongovernmental organizations as implementors. In Zaire's Third Water Supply Project, the lead implementing agencies have involved local villagers and nongovernmental organizations in the operation and maintenance of the rural water supply. Attempts to shift these responsibilities to local communities are to be accompanied by training and technical assistance. On-the-spot repairs and periodic maintenance are organized to help incorporate villagers and local mechanics in these activities. The expectation is that this participation and sense of ownership will lead to higher collection rates. In the Senegal Debi-Lampsar Irrigation Project, great care was taken to incorporate farmer groups at various stages of project development. SAED, the state water corporation, provided literacy and administrative training. Farmer groups are responsible for coordinating activities such as water delivery, crop spraying, and the maintenance of secondary and tertiary canals and dikes in their irrigation quarter. To increase farmer participation in perimeter management, a joint SAED-farmer committee was established, with authority on specific questions of implementation of the agriculture program. The mechanism is proving invaluable for giving farmers a voice in operations and in helping SAED to become more responsive. For delicate problems such as establishing penalties for debt delinquencies, the committee's decisions have been more acceptable to farmers than in the past because these decisions are made by their representatives.

Box 7.1
Institutional Performance and Irrigation Development: the Need for Beneficiary Participation

A recent study by the Operations Evaluation Department focuses on four irrigation projects in the Philippines and Thailand and points to institutional shortcomings that have affected project performance. The four projects were the Philippines Upper Pampanga and Aurora-Penaranda Irrigation Projects and, in Thailand, the Northwest Irrigation Projects I and II.

One key finding is the benefit of incorporating beneficiaries in all stages of project development. While all projects envisioned the creation of water-user groups to be responsible for operation and maintenance in the tertiary irrigation system and for water distribution below the main canals, none was successful. In particular, this is disconcerting for the Philippines, where farmers are renowned for the quality of their participation.

Several factors account for the four projects' poor performance. First, beneficiary associations were not allowed to participate much in project design. As a result, an irrigation system of central control versus arranged demand developed, where the determination of the rate, frequency, and duration of canal irrigation was not determined jointly between users and agency. Farmer ownership and operation and maintenance responsibilities were not clearly established at the outset. Second, the projects did not address the internal conflicts that often occur in large associations; this happened because community characteristics were not given enough attention during preparation. Third, little training for farmers was provided. As a result, small-scale, inexperienced farmers were expected to take over functions for which they were ill-prepared and from which few benefits were perceived. In addition, the separation of irrigation system functions and agricultural extension functions in separate agencies compounds the problem of agency coordination by confusing beneficiaries. Irrigation agencies remain dominated by an engineering orientation with little agricultural experience. And, extension services are ill-prepared to advise farmers on irrigation techniques.

The results of these failures to recognize beneficiary roles are significant. The expected life of the systems is estimated to be reduced by 15 to 45 percent; in spite of high agency staffing, regular maintenance does not happen; collection rates declined in 1982-88 from 54 to 35 percent; and interagency coordination has become a permanent problem, well beyond project completion. A vicious cycle emerges where weak initial design leads to declining performance, which leads to dissatisfaction among unengaged farmers. This, in turn, leads to low cost recovery, which leads to financial difficulties for project authorities, and poor performance.

Source: Operations Evaluation Department 1990.

7.29 The effectiveness and potential of voice also can be enhanced using mechanisms to insure the open flow of information from client or user to the implementing agency. In the Philippines Third Ports Project, a consumer section created for the project helped with promotion, marketing, and feedback. In the Mexican Ports Rehabilitation Project, the port service companies incorporate users in the port development committees to encourage responsiveness to demands. In the Korean Kyonggi Regional Transport Project, a committee has been established to review the investment program and make major investment decisions. The committee is composed of members of several government agencies and representatives of the private sector and the academic and research communities. A solid decisionmaking process involving key stakeholders has been

established for infrastructure investments in the region. In each case, mechanisms to enhance the opportunity of voice have made—or are expected to make—the difference between success and failure. In addition, ownership, feedback mechanisms, links between local and apex organizations, reduced project complexity, clarity about responsibilities, and accountability have helped create incentives for providers and users.

The Bias against Maintenance

7.30 Most infrastructure sectors exhibit a systematic bias in favor of new construction at the expense of maintenance—and even at the expense of efficient operations. In highways, railways, ports, and electric power there has been surprising consistency in the creation of excess capacity—and the problems associated with continued emphasis on construction instead of rehabilitation and maintenance. There are regional differences—with East Asia needing expansion of the systems—but this bias is quite widespread.

7.31 Key factors in the neglect of maintenance include the inability to exclude users who feel little responsibility, biases in donor incentives against supervision and postproject accountability, the failure to include beneficiaries in project design, and top-down approaches that emphasize the use of complex technologies and have little concern for long-term maintenance. Other key factors include the use of government force-account agencies with little incentive to provide day-to-day continuity in operations and with distorted incentives for government staffs, who perceive their long-term interests and political gain in the more visible side of infrastructure—construction. A recent study in Latin America found an enormous backlog of road maintenance and rehabilitation. Although the overall backlog was about 45 percent in nine of twenty-two countries or states there was a backlog of from 50 to 100 percent (Mason and Miquel 1988). The main reasons for this poor performance were age of network, low productivity of maintenance staff, inadequate allocation of maintenance funds, misallocation of available funds, and lack of monitoring and enforcement (for example, of weight limitations).

7.32 In each case, however, what is identified are mostly proximate causes of the maintenance dilemma. It has been argued that one reason for this predilection for new construction over more labor-intensive operations and maintenance is the result of the specificity and technical rationality inherent in capital-intensive and standardized construction activities (Israel 1987; Moore 1989). In part, this focus on short-term technical rationality—construction activities in this case—versus the longer-term process of institutional development (recurrent maintenance activities) is endemic. Providing short-term solutions can conflict with long-term institutional development needs. As indicated, in roads these underlying difficulties are exacerbated by the institutional separation between the collection of revenues—the ministry of finance—and the expenditures—the road agency.

7.33 Part of the bias toward new construction stems from the nature of donor financing. A recent study of the Philippines showed that Bank efforts continued to concentrate on road construction—even while recognizing the deplorable condition of rural road maintenance. Maintenance was treated as a subordinated activity; its design was simplistic and a residual effort; casual monitoring and supervision prevailed. Agencies responsible for district road maintenance performed alternatingly among the national, provincial, and local levels, without much planning. In addition, decentralization efforts occurred in a planning vacuum, resulting in obscure guiding

principles, confusing interagency arrangements, and poorly sorted-out operational responsibilities. This bias toward construction is being reduced at the Bank, which has already financed several highway maintenance operations.

7.34 There is a tendency to view external financing for new investments as free money and a resultant tendency to allow deterioration to occur—including in the United States. Grants for expanding urban water and sewer systems encouraged localities in the 1970s to overbuild systems that later required extensive maintenance. Maintenance, however, depended largely on the local capacity to raise revenues through fees and taxes. New systems put in place became long-term burdens for recurrent budgets, which do not compete effectively during fiscal crises. Scarce resources, low political visibility of maintenance operations, and short-term horizons for political leadership and bureaucrats meant that maintenance activities became low priorities (Pagano and Moore 1985).

7.35 The lack of attention to maintenance partly reflects a lack of political commitment. Not only does the high visibility of construction activities give them high political priority, but the weakness of low-income local—especially rural—constituencies in making their demands heard means that in the absence of voice, constituents often exercise their exit option—nonmaintenance, minimal commitment to community operating activities, and nonpayment for services. In a sense, fee payment should be viewed not only as a rationalization of cost recovery but as a political statement.

7.36 The failure to involve local communities in decisionmaking can often lead to the application of inappropriate technologies which favor construction over maintenance. In Sierra Leone, CARE has had principal responsibility for rural road programs. The original intent was to build low-cost labor-intensive roads. Instead, capital-intensive and relatively expensive construction took place. The main reason was CARE's decision that higher-cost feeder roads were needed to "build in" maintenance because of government weaknesses in this. At the same time, however, CARE unwittingly undermined existing self-help traditions by deciding that special local groups should maintain the roads. In addition, there is no local identification with the roads because beneficiaries were not involved in the construction (Carapetis and others 1984).

7.37 Thus, the managerial and financial problems used to explain the neglect of maintenance are important but do not go to the heart of the matter. Both the present incentive systems in the countries and the donor agencies make such a bias almost inevitable. In many countries, government agencies give external assistance little value, yet value internal resources highly. Donors still give lending a high priority and give local recurrent expenditures in the countries a low value. Until this asymmetry is solved, the bias will persist.

Table A.1
World Bank Lending for Infrastructure
Number of Projects and Loan Amount
(millions of U.S. dollars)

	1975		1976		1977		1978		1979		1980		1981		1982		1983		1984		1985		1986		1987		1988		1989	
	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt	No.	LnAmt
ion	13	473.7	12	594.0	22	769.0	17	759.9	19	767.5	19	1319.5	24	1355.8	11	826.0	19	1029.9	13	902.1	14	1081.2	17	1405.1	8	418.4	13	941.7	5	580.4
ic Power	10	503.7	20	949.3	17	951.5	19	1146.2	18	1354.9	25	2392.3	17	1323.0	22	2131.2	16	1768.2	25	2651.3	17	2250.3	26	2786.9	24	3016.9	17	2006.9	17	3282.9
mmunications	8	199.0	5	64.2	2	140.0	5	221.1	2	110.0	4	131.0	3	329.2	9	395.8	2	57.0	3	166.5	5	121.6	3	50.4	7	682.3	1	36.0	7	161.0
ortation	27	988.7	35	1370.9	34	1047.6	33	1092.2	38	1904.4	28	1444.5	28	1062.8	30	1614.2	30	1923.6	29	2596.9	27	2138.7	24	1498.2	25	1745.9	34	2642.5	22	1830.8
ds	14	295.2	20	738.1	20	650.5	21	655.7	28	1264.9	18	795.5	17	570.3	20	1055.3	19	1007.7	20	1582.6	13	898.1	12	781.7	16	1217.7	19	1313.6	8	774.2
lways	5	437.0	5	325.3	4	125.5	4	259.2	5	382.7	4	337.0	3	271.0	2	103.0	2	450.0	5	676.7	4	755.0	4	329.9	4	380.0	7	856.0	4	332.0
ts	5	164.0	8	229.5	9	246.6	7	163.0	3	88.8	6	312.0	2	58.0	7	330.9	7	257.7	3	333.8	6	381.7	7	384.6	5	148.2	5	259.6	3	175.4
er	3	92.5	2	78.0	1	25.0	0	0.0	2	68.8	0	0.0	1	58.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
tor Loans ultimodal)	0	0.0	0	0.0	0	0.0	1	15.0	0	0.0	0	0.0	4	105.5	1	125.0	2	208.2	1	3.8	4	103.9	1	2.0	0	0.0	3	213.3	7	549.2
Supply & itation	10	145.1	11	334.6	13	300.7	16	375.2	22	1018.8	16	631.0	11	534.6	10	441.2	19	810.9	13	640.8	13	780.8	14	604.8	16	969.5	6	535.3	10	791.2
tructure	68	2310	83	3313	88	3209	90	3595	99	5056	92	5918	82	4605	82	5408	86	5590	83	6958	76	6373	84	6345	80	6833	71	6162	61	6646
Bank Lending		5896		6632		7067		8411		10011		11482		12291		13016		14477		15524		14386		16319		17674		19221		21367
tructure Loans Proportion of tal Lending		39.2%		50.0%		45.4%		42.7%		50.5%		51.5%		37.5%		41.6%		38.6%		44.8%		44.3%		38.9%		38.7%		32.1%		31.1%

e: World Bank Annual Reports, Various Issues.
rban Loans not included.

Table A.2
World Bank Lending for Infrastructure by Region and Subsector
(million US dollars)

	Africa			Asia			Emena			LAC			Total for All 4 Regions		
Sector	1979	1984	1989	1979	1984	1989	1979	1984	1989	1979	1984	1989	1979	1984	1989
Irrigation	15.0	0.0	0.0	489.5	752.1	325.0	138.0	142.3	184.4	125.0	7.7	71.0	767.5	902.1	580.4
Electric Power	10.1	219.6	138.4	722.8	1280.0	1993.5	276	208.7	415.0	346.0	843.0	736.0	1354.9	2651.3	3282.9
Telecommunication	20.0	0.0	103.3	90.0	8.5	12.7	0.0	128.0	0.0	0.0	30.0	45.0	110.0	166.5	161.1
Transportation	433.1	463.7	248.7	596.2	1322.7	1136.8	406.6	309.4	296	468.5	501.1	149.3	1904.4	2596.9	1830.8
Roads	332.3	390.2	34.7	289.5	572.0	708.0	331.6	199.4	0.0	311.5	421.0	31.5	1264.9	1582.6	774.2
Railways	80.0	66.0	7.0	206.7	500.7	150.0	0.0	110.0	138.0	96.0	0.0	37.0	382.7	676.7	332.0
Ports	113.8	7.5	0.0	0.0	250.0	112.4	75.0	0.0	63.0	0.0	76.3	0.0	88.8	333.8	175.4
Other	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.0	0.0	0.0	68.0	0.0	0.0
Sector Loans	0.0	0.0	207.0	0.0	0.0	166.4	0.0	0.0	95.0	0.0	3.8	80.8	0.0	3.8	549.2
Water & Sanitation	141.0	32.9	238.2	591	151.5	0.0	117.0	427.8	233	169.8	28.6	320.0	1018.0	640.8	791.2
Total Infrastructure*	619.2	716.2	728.6	2389.5	2514.8	3468.0	937.6	1316.2	1128.4	1109.3	1410.4	1321.3	5055.6	6957.6	6646.3
Total Bank/IDA Lending	1202.1	2368.3	3924.7	4207	7002.6	7832.5	2336.6	3125.8	3767.5	2264.8	3027.5	5842.1	10010.5	15524.2	21366.8
Infrastructure* as Proportion of Total	51.5%	30.2%	18.6%	56.8%	50.2%	44.3%	40.1%	42.1%	30.0%	49.0%	46.6%	22.6%	50.5%	44.8%	31.1%

Source: World Bank Annual Reports.
* Urban Loans Not Included.

Table A.3
World Bank: Ex Post Rates of Return of Infrastructure Investments

Unweighted-Average Re-estimated Economic Rates of Return					
Sector	**1980**	**1982**	**1984**	**1986**	**1988**
Irrigation	30	22	20	14	11
Electric Power	8	13	11	11	11
Telecommunications	21	18	24	13	20
Transport				23	20
Highways	23	17	22		
Railways	20	13	22		
Ports	16	24	17		
Water Supply & Sanitation	7	7	11	8	12
Average of All Bank Operations	17	14	12	16	17

* Urban Loans Not Included.
Source: World Bank, OED Annual Review of Project Performance Results.

Table A.4
World Bank: Ex Post Rates of Return of Infrastructure Investments

Weighted-Average Re-estimated Economic Rates of Return					
Sector	**1980**	**1982**	**1984**	**1986**	**1988**
Irrigation	30	24	17	13	10
Electric Power	6	14	10	12	10
Telecommunications	21	18	24	13	19
Transport	25	18	23	19	27
Highways	26	17	24		
Railways	21	13	22		
Ports	16	29	17		
Water Supply & Sanitation	6	6	12	8	10
Weighted Avg. ERR All Sectors	17	21	16	16	15

* Urban Loans Not Included.
Source: World Bank, OED Annual Review of Project Performance Results.

Table A.5
Staff Appraisal Report Ratings for Institutional Development Programs
(percentages)

Infrastructure (40)	Weak	Adequate	Good
Roads (7)	12	25	63
Ports (2)			100
Water/Sewerage (8)	25	25	50
Power/Energy (7)	14	28	57
Telecommunications (1)	100		
Irrigation (7)	43	28	28
Urban/Municipal (7)	14	28	57
Total	20	28	52
Non-Infrastructure (92)	38	24	38

Source: Moore (December 1989); Gray and others (June 1990).

Table A.6a

Infrastructure-Supply Performance

COUNTRY	ROADS	RAILWAYS	PORTS	POWER	TELECOMM	WATER SUPPLY	IRRIGATION
BANGLADESH	Network expanded; traffic increased.	Freight and passenger traffic declined.		Access only to 5% of population.	Expanded.	Supply increased; access declined, because of population increases; urban access slightly improved.	
BRAZIL	Network expanded; traffic increased;vehicle fleet grew;congestion in urban areas.	Freight traffic increased; long distance passenger traffic declined.	Container traffic increased.	Power consumption grew; Access 67%; urban access 89%; inadequate transmission capacity for generation capacity.	Expanded.	Greatly expanded; access 84%; rural access 71%; and urban access 89%.	90% of irrigation developed by private sector.
COLOMBIA	Network expanded; priority to rural roads; traffic increased.	Freight and passenger traffic declined.	Traffic declined; expected to increase in 1985-90.	Access 95% in large cities; consumption grew; excess reserve capacity.		Access to water 57%; to sewerage 41%; lower access in rural areas.	More than half of irrigation in private sector. Poor on-farm development in public irrigation.
HUNGARY	Network expanded slightly;traffic increased; vehicle fleet grew.	Freight and passenger traffic declined.		Access improved.	Expanded; capacity too small for the economy; large unsatisfied demand & long waiting.	Access improved in rural and urban areas.	
INDIA	Network expanded: emphasis on rural roads; traffic and vehicle fleet grew.	Freight and passenger traffic increased.	Traffic increased; container traffic increased. Traffic close to capacity in some ports and excess capacity in smaller ports.	Access 14%; shortages persist; unbalanced investments in generation, transmission, and distribution.	Expanded; long waiting periods for connections; severe underinvestment.	Supply increased; access improved. Coverage in rural areas increased more rapidly than in urban areas. Supply intermittent and unreliable in many cities; acute shortage in Madras.	One-third of cultivable area irrigated; irrigation potential has risen to 61.5 million ha. (1984), with an estimated 93% of potential used.
KENYA	Network expanded; traffic increased.	Freight traffic declined; passenger traffic fluctuated.	Ample capacity; traffic generally grew.	Access only 5%.		Access 100% in urban and 15% in rural areas.	
MOROCCO	Network expanded; traffic and vehicle fleet grew.	Freight and passenger traffic increased.	Traffic increased.	Limited access; installed capacity constant after 1985.	Long waiting (up to 6 years); supply insufficient.	Access improved in urban, declined in rural areas.	Expanded.
NIGERIA	Network expanded substantially; traffic increased.	Freight and passenger traffic declined.	Port capacity adequate for current traffic levels.	Access 16%; many small urban centers not yet electrified.Long waiting for connection.	Access limited to 20% of country area; long waiting (up to 10 years)	Supply inadequate; access to water 20% rural, 100% urban; acute supply shortages in Lagos.	
THAILAND	Network expanded; traffic and vehicle fleet increased.	Freight traffic increased; passenger traffic declined.	Traffic increased; container traffic growth faster than conventional cargo traffic growth.	Per capita consumption higher than average for countries at similar income levels.	Supply expanded; but demand growth faster.	Access improved in rural areas; declined in urban areas.	Irrigation expanded; weak distribution systems.

Table A.6b
Condition of Infrastructure

COUNTRY	ROADS	RAILWAYS	PORTS	POWER	TELECOMM	WATER SUPPLY	IRRIGATION
BANGLADESH	Main paved network: poor/fair/good: 45%/40%/15%; main unpaved network: 50% in poor condition (1984 data). Inadequate maintenance.	Aged; ailing.		Defects in distribution system; poor maintenance of generating plants.		Generally good; mostly built in the early 1960s; older facilities in poor condition.	
BRAZIL	Main paved network: poor/fair/good: 24%/34%/42% in 1987-88; Inadequate maintenance; substantial new construction.	Tracks in poor condition, locomotives old; poor maintenance.				Large part of system built in last 20 years, and in satisfactory condition.	
COLOMBIA	Main paved network: Poor/fair/good: 21%/37%/42% in 1984; network deteriorated; level of maint. exp adequate now.	Tracks and equipment in poor condition. Poor maintenance.	3 out of 4 ports deteriorated, because of poor maintenance, old age, and in some cases poor construction.	Distribution system has deteriorated because of inadequate maintenance, and investment.		Good condition in large cities, but inadequate maintenance otherwise; inappropriate technology.	Good for private irrigation systems, but poor for public systems; inadequate maintenance and rehabilitation.
HUNGARY	Part of the system needs rehabilitation; maintenance inadequate for the increased traffic.	Track and fleet in good condition; track machinery old; shortage of maintenance equipment and marshalling yard capacity.		Modern system in good condition.	Technically obsolete; 28% of exchanges need replacement in 1986.		
INDIA	Main paved network: poor/fair/good: 35%/45%/20%; maintenance inadequate.	Tracks in poor condition; obsolete motive power, terminals, and locomotives.	Obsolete system; poor maintenance; severe foreign exchange constraint.	Plants, transmission and distribution systems in poor condition; inadequate maintenance; shortage of funds for spare parts needed for repairs.	Obsolete technology; substandard equipment.	Water supply systems in poor state in many cities; defective equipment.	Maintenance adequate in Punjab.
KENYA	Main paved network: poor/fair/good: 16%/52%/32%; main unpaved network 17%/17%/66% in 1984; maintenance inadequate.	Locomotives in poor condition, due to old age, poor maintenance.	Berths, oil terminals, cranes, fork-lift fleet need rehabilitation.			Rural water supply and municipal sewerage systems need rehabilitation; inadequate maintenance.	
MOROCCO	Net work deteriorated; main paved network: poor/fair/good:: 36%/44%/20%.; maintenance inadequate .		Generally satisfactory, except for breakwater rehabilitation and dredging.	Maintenance generally satisfactory; lack of standardization of equipment between the apex organization, and the regional utilities.	Existing services reasonably well-maintained.	Water supply system satisfactory; sewerage systems in state of disrepair.	Conditions vary; inadequate funds and staff.
NIGERIA	Main paved federal network: poor/fair/good:: 23%/15/62%;(1984); maintenance inadequate.			Poor condition; 40% of generating units non-operational; poor maintenance.	Poor maintenance; lack of spare parts; faulty common control equipment.	Severe deterioration of even relatively new systems due to inadequate maintenance.	
THAILAND	Main paved network: poor/fair/good:: 20%/30%/50%;in 1984; 4,500 km of existing highways need rehabilitation.	Tracks adequately maintained; signaling system poor.	Maintenance of existing facilities adequate; some equipment obsolete.	Generally satisfactorily maintained.			Much of the system needs modernization.

Table A.6c
Infrastructure - Operating Performance

COUNTRY	ROADS	RAILWAYS	PORTS	POWER	TELECOMM	WATER SUPPLY	IRRIGATION
BANGLADESH	Bus passenger transport overloaded, because of low tariffs set by govt.	Inefficient, unreliable, and long delays; low labor productivity.	Low productivity, and long ship turn-around times.	High system losses, overstaffing, high outage rates.	Poor call completion rates. staff growth rate less than the DELs.	Poor operation- significant water shortages in Dhakha. overstaffed.	
BRAZIL	Poor traffic management; traffic congestion; suboptimal routing of buses. Weight laws not enforced adequately.	Operating performance mixed; overall satisfactory, compared with other developing countries; labor productivity improving.	Inefficient.	Performance varies among the utilities; higher system losses in some, owing to inadequate transmission investments.		Water losses about 29% of water produced; losses higher in the northern states, consumers served per employee higher in the Southern states.	Private sector irrigation efficient; public projects fare poorly.
COLOMBIA	Transport costs high inappropriate govt. regulations; lack of coordination in transit documentation.	Locomotive productivity in terms of traffic units low; excessive administrative staff; lack of skilled technicians.	Low productivity; long idle time of ships at berths.	Electricity losses increased.		Water companies in big cities efficient; large water losses; excessive political interference in operations.	Private irrigation efficient; low cropping intensity and field efficiency in the public systems.
HUNGARY	Efficient; productivity of trucking operations improved.	Overall satisfactory; wagon turn-around time increased.		Satisfactory; system losses low.	Long delays; poor call completion rates.		
INDIA	Low productivity; excessive regulations, cumbersome taxation, overstaffing, high accident rate; severe congestion.	Overall satisfactory; productivity increasing	Excessive berthing delays, cumbersome customs procedures, massive documentation, high handling costs.	Quality of service poor; frequent outages, voltage fluctuations, high system losses, inadequate transmission and distribution network, political interference in operations of state utilities.	Poor service; heavy congestion, poor call completion rates.	Inadequate and poor; interruptions in supply are common; Water supply vulnerable to droughts;	Uncertain power, inadequate maintenance, weak institutional basis are some of the operational problems.
KENYA	Suboptimal intermodal traffic distribution in the main traffic corridor.	Low labor productivity; wagon turn-around time long.	Low operational efficiency; poor handling and loading of cargo; lack of coordination in devpt. of containerization.			Physical losses in Nairobi approached 40-50% of water supply, but then reduced to 30%. Poor O&M in rural water supply and municipal sewerage systems.	
MOROCCO	Intermodal coordination needed. Long and medium freight handled inefficiently by small vehicles.	Labor productivity improving.	Substantial improvement in last 5 years; need to simply cargo documentation; conventional cargo handling poor.	Generally satisfactory. Distribution losses high, because of deteriorating distribution systems; over staffed; inadequate coordination between the regional utilities and the apex utility.	Peak local call completion rates poor; no. of employees compares favorably with the neighboring countries.	Unaccounted — for water 30%. Staff level reasonable; quality of water satisfactory in urban areas; leaking water pipes make potential for contamination high .	Large-scale schemes well designed and operated; reliability and timeliness of water distribution satisfactory.
NIGERIA	Overloading, poor maintenance, poor quality of construction.	Low labor productivity, but improving.	Ship waiting time considerably reduced.	Poor reliability of the transmission system; overloading of power transformers; frequent power shedding, high system losses.	Service quality poor; congestion; low call-completion rates.	Unsatisfactory. Unreliable water treatment plants; excessive staff at the lower levels,withg minimal or no technically qualified personnel.	
THAILAND	Congestion, pollution.	Well-managed. Productivity increasing.	Generally satisfactory. excessive storage time.	Frequent poer outages, and voltage fluctuations.	Poor.	Unreliable, poorly timed, and largely uncontrolled delivery system. O&M tandard low.	

Table A.6d
Infrastructure - Financial Performance

COUNTRY	ROADS	RAILWAYS	PORTS	POWER	TELECOMM	WATER SUPPLY	IRRIGATION
BANGLADESH	Road user revenue exceeds road expenditures; maintenance expenditures inadequate. Bus passengers subsidized.	Heavily subsidized; high volume of ticketless travel.		Average tariffs cover only 70% of LRMC. Rural power heavily subsidized. Poor billing, heavy govt. arrears.	Tariff high compared with to other LDCs at similar income levels. Rate of return 33%; 50% of investment financed from internal resources.	Tariff increases lower than inflation during 1980-85; operating deficits chronic.	
BRAZIL	Road expenditures in recent years almost equal to road user revenues. Now trucks can be charged, adequate to cover costs. Public transport companies do not fully recover costs.	Heavy annual losses; passenger traffic source of losses; freight traffic profitable; huge debts, and inadequate tariffs.	Planning, budgeting and costing are weak; tariffs not related to costs.	Average tariff was about 75% of LRMC in 1989; explicit subsidy to rural consumers and water supply and sewerage companies; internal funding negative; ELECTROBAS, the national-level holding company has been well managed.		Weak; tariff increases lag behind inflation; escalating operating costs, because of higher costs of power, and chemicals; heavy budgeteray support; high municipal arrears.	Poor cost recovery; public irrigation costs per hectare are much higher compared with private schemes.
COLOMBIA	Road user charges exceed road expenditures, which are below requirements; Heavy vehicles do not fully pay.	Substantial operating deficits; Tariff increases not adequate to cover inflation costs.	Financially independent, no budgetary support from the govt. Operating ratio declined in 1982-84, and is expected to decline to 50% by 1989-90.	Serious financial difficulties: low tariffs,poor return, low internal fund generation, high power losses, heavy arrears from public sector.		Tariffs too low; poor collection performance; internal funding of investment only 15%.	No tradition of paying water charges on public schemes. Water charges covered less than 30% of O&M in 1987. Cost recovery in Bank assisted projects generally good.
HUNGARY	Freight revenues overall cover costs; passenger tariffs subsidized; maintenance spending inadequate -- heavy vehicles pay less than their share.	Overall position healthy; rate of return declined; but freight revenues cover costs; passenger revenues cover 35% of cost.		Satisfactory; average tariff higher than LRMC.	Financial situation satisfactory; rate of return 20% in 1990; net internal cash generation 94% of capital investments.		
INDIA	Road-user taxes far in excess of spending; heavy vehicles pay less.	Revenues cover costs; freight revenues exceed costs; passenger revenues cover only 50% of costs.	Sector as a whole covers costs; high port charges; cross subsidization of losing ports.	State electricity boards as a whole incur losses; situation varies from state to state; capital expenditure financed by debt; average tariff 60-70% of LRMC; heavy subsidy for agriculture.		Generally satisfactory.	Tariffs do not cover O&M costs in some states; low collection rates; arrears from local govts.Cost recovery about 70% in Punjab and Karnataka.
KENYA	Road-user revenues exceed road expenditures, which are inadequate; heavy vehicles pay less than costs.	Chronic losses; declining real tariffs.	Worsening; some charges excessive.	Generally satisfactory; average tariff less than LRMC; excessive subsidy for poor.		Tariff inadequate; heavy arrears, especially from govt agencies.	
MOROCCO	Road-user revenues exceed costs; heavy vehicles pay less than costs.	Heavy budgetary support.	Satisfactory; cross subsidization of ports incurring losses; tariff structure inadequate;	Improving; heavy arrears from govt. depts. Heavy subsidy to low-income consumers.	Satisfactory; no peak off-peak pricing; heavy arrears from govt. depts.	Tariff structure adequate; collection from public agencies poor.	Good cost recovery in Bank projects.
NIGERIA	Road-user less than revenues exceed costs; much of the expenditure on construction, and less on maintenance.	Unsatisfactory; incur heavy losses.	Finances deteriorated; poor collection, & asset maintenance, chronic operating deficits.	Poor financial performance during 1985-87; heavy losses, low tariffs, heavy arrears.	Unsatisfactory; too dependent on govt. support; poor billing and collection.		
THAILAND	Road-user charges cover expenditures; Bangkok Urban Metro-transport incurs operating losses.	Operating losses increasing; higher labor and fuel costs; inadequate tariff increases.	Generally satisfactory; profitable operations.	Financial position sound. Heavy debt.			Cost recovery not enforced in public projects.

Table A.7
Telecommunications Sector: Unsatisfied Demand, 1979 and 1988

		(Number in thousands)				Waiting List as Percentage of Total Demand		
		Main Lines		Waitlisted				
	Country	1979	1988	1979	1988	1979	1988	Change
1	Turkey	1,092	4,921	1,535	37	58.4	0.7	-57.7
2	Korea	2,341	10,486	619	51	20.9	0.5	-20.4
3	Malaysia	325	1,248	106	69	24.5	5.3	-19.3
4	Argentina	1,797	2,748	863	789	32.4	22.3	-10.1
5	Thailand	332	1,006	194	377	36.9	27.3	-9.6
6	Kenya	70	157	40	64	36.5	28.9	-7.6
7	Costa Rica	134	257	12	14	8.3	5.1	-3.2
8	Portugal	940	1,849	127	178	11.9	8.8	-3.1
9	Chile	351	626	139	237	28.4	27.4	-0.9
10	Tunisia	100	249	43	104	30.2	29.6	-0.6
11	Uganda	21	28	19	25	47.9	47.6	-0.3
12	China	4,335	8,653	164	484	3.6	5.3	1.7
13	Sudan	44	58	15	22	25.2	27.5	2.3
14	Zambia	30	59	13	29	30.	33.2	2.8
15	Uruguay	212	345	45	93	17.5	21.3	3.8
16	Sri Lanka	54	104	22	51	28.7	33.0	4.3
17	Mexico	2,494	3,821	314	757	11.2	16.5	5.4
18	Senegal	17	29	3	8	15.9	21.3	5.4
19	Poland	1,852	2,953	926	2,189	33.3	42.6	9.2
20	Malawi	11	23	1	6	10.3	19.9	9.6
21	Morocco	154	287	69	205	30.9	41.7	10.7
22	Algeria	260	697	118	524	31.2	42.9	11.7
23	Ghana	36	40	16	30	30.6	42.3	11.7
24	India	1,868	3,488	241	1,125	11.4	24.4	13.0
25	Zimbabwe	93	118	5	32	5.3	21.3	16.0
26	Tanzania	38	66	18	76	32.3	53.5	21.1
27	Indonesia	318	829	43	549	11.9	39.9	28.0
28	Ethiopia	61	113	9	88	13.0	43.8	30.9

Source: International Telecommunications Union Yearbook.
Total Demand = Total Lines Connected + Number in the Waiting List.

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