

## **Infrastructure and Pro-poor Growth**

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## Introduction

The Millennium Development Goals (MDGs) recently articulated by the United Nations have set a target of halving poverty and malnutrition from their 1990 levels over a twenty-five year period (by 2015). However, the performance of developing countries over the past decade has been mixed and, in some regions, dismal. Both the poverty rate and the number of poor declined in South Asia during the 1990s (the latter by 3.6 percent), but the prevalence of malnutrition remains higher in this region than elsewhere<sup>1</sup>. In contrast, the poverty rate and the number of poor increased in sub-Saharan Africa during the 1990s, as did the prevalence of malnutrition. It seems clear that a “business as usual” approach is not going to achieve the MDGs and that a more effective poverty alleviation strategy is urgently required. One also needs to recognize that even if one succeeds in reaching the MDGs, the job remains only half done. Persistent poverty and malnutrition result in irreversible costs to human and economic development.

Numerous studies have shown that public spending in rural infrastructure is one of the most powerful instruments that governments can use to promote economic growth and poverty reduction. Investments in roads, electricity, telecommunications and other infrastructure services are crucial for stimulating growth in agriculture and rural areas, and for food security and poverty reduction. However, public investment in infrastructure has stagnated in recent years in many developing countries and has fallen as a share of both total government expenditure and GDP (Fan and Rao, 2003). This stagnation has been driven in part by the need to cut total public expenditure as part of structural adjustment programs, but also by the low priority attached to infrastructure since the mid-1980s by many governments and donor agencies. There has been a naïve belief that private investment will fill the gap left by the public sector. To be sure, the private sector can and will play an increased role in providing some kinds of infrastructure services. But without complementary public investments and a well-established legal and regulatory framework, private investment will not come automatically. Moreover, rural roads, particularly in many backward and remote areas are hardly profitable to the private sector.

It is already clear that in many poor countries it will be impossible to reach the MDGs without increased public investment, particularly in infrastructure in rural areas. But public resources must also be used efficiently. This will require more efficient targeting of investment resources to achieve growth, poverty and environmental goals, and improved efficiency within the agencies that provide public goods and services.

This paper is structured as follow. We first review recent trends in government spending on infrastructure as well as the literature on the relationships between infrastructure development and poverty reduction. We then draw on several IFPRI case studies to highlight how rural infrastructure development has helped in reducing poverty, and the kinds of investments that are win-win for growth and poverty reduction. We then discuss institutional aspects in the delivery

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<sup>1</sup> Measured as people living on less than \$1 a day with data taken from the MDG website: <http://www.developmentgoals.org>.

of public services, and ways in which public and private sector roles can be strengthened. We close with some brief policy conclusions.

### **Trends in Infrastructure Investment**

Total government spending on infrastructure (transportation and telecommunication) for 43 developing countries included in a recent IFPRI study (Fan and Rao, 2003) increased very modestly from \$83.5 billion in 1980 to \$89 billion in 1998 (Table 2) in constant 1995 prices. This increase masks a dramatic 30% decline in public investment during the 1980s, the era of macroeconomic structural adjustment programs, and the 1990s have really been a period of recovery rather than of net increase. The primary rationale for SAPs was to reduce government spending to create an enabling environment for markets to function more efficiently. However, the most productive sectors in developing countries often suffered the consequences of this decreased spending. Government spending in agriculture, education, health, and infrastructure, were its primary casualties.<sup>2</sup>

As a percentage of GDP, the decline is even more significant (Table 2). For all 43 countries included in the Fan and Rao study, infrastructure spending declined from 2.1% of total GDP in 1980, to 0.86% in 1990 and to 0.81% in 1998. For Africa as a whole, the percentage dropped from 1.86 to 1.1 between 1980 and 1998. For Asia, the percentage dropped from 2.2 percent to less than one percent. Part of this decline can be explained by the privatization of many formerly state-owned enterprises in the transportation sector. Latin America reduced its infrastructure expenditure from 1.92 percent of GDP in 1980 to 0.9 percent in 1998.

Compared to other types of spending, infrastructure often receives only a small share in total government spending (Table 1). The top three expenditures items for Africa in 1998 were education, defense, and health. Defense accounted for 10 percent of total government spending in Africa in 1998 compared to 4% for infrastructure. Infrastructure's share also declined from 6% in 1980 to 4% in 1998. In Asia, infrastructure's share dropped more than half, from 12 percent in 1980 to 5 percent in 1998. In Latin America, the share declined from 11 percent to 6 percent over the same period.

As a result of inadequate levels of investment in infrastructure, rural roads in many developing countries have deteriorated over time. For example in China, while high quality urban roads have increased exponentially for the last two decades (by 44% per annum between 1988 and 2002 for expressways), there has been hardly any improvement in rural roads. In fact, the length of rural roads (sub-standard) declined by more than 1% per annum between 1980 and 2002. There are currently about 184 towns and 54,000 villages that still do not have proper access to roads in rural China, most of which are located in the western regions (Fan and Chan-Kang,

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<sup>2</sup> Fan and Rao modeled the impact of the structural adjustment programs on the composition of government spending for the 43 developing countries. They found that countries in Africa and Latin America have reduced their spending share on infrastructure as a result of their adjustment programs.

2004). In India, due to increased government spending in input and output subsidies, growth in investment in rural infrastructure has declined in recent years (Fan, Thorat and Rao, 2004).

The situation in Sub-Sahara Africa is even more worrisome. The average road density in rural areas for the continent is 34 m/km<sup>2</sup> (World Bank). This is only 23% of the density in China (Fan and Chan-Kang, 2004) and 4% of the density in India (World Bank, 2002). Poor road access leads to higher transaction costs for many farmers when selling their produce. For example, high transaction costs are equivalent to a value added tax of 15% for Kenyan farmers (Renkow, et al., 2004). Transportation charges in rural Ghana and Zimbabwe are 2-2.5 times higher than in Thailand, Pakistan, and Sri Lanka (Torero, 2004).

### **How Infrastructure Reduces Rural Poverty**

In this section we review the state of current knowledge about the linkages between infrastructure and poverty reduction, paying particular attention to the relationship between rural infrastructure and poverty reduction. We do not question the validity of demonstrated relationships between infrastructure investments and economic growth as done by some other scholars (Kessides, 1993; World Bank, 1994; Canning, 1999). Until very recently, the direct impact of infrastructure was not perceived to be an important means for poverty reduction. But infrastructure has multiple links to poverty reduction, as highlighted in the World Bank's Annual Report 2001. Improved infrastructure helps create jobs and raise worker productivity. It saves time and human effort in transporting water, crops, wood, and other commodities. It also improves health (by reducing indoor air pollution and emissions in urban areas and making clean water available) and education (by expanding access to schools, computers, and lighting).

Among all types of rural infrastructure, rural transport is probably the most crucial for the livelihoods of the rural poor. It encompasses transport activities at all levels, whether local, regional or national. It is composed of two elements: (1) rural transport services for passengers and freight by non-motorized and motorized means of transport, and (2) rural transport infrastructure, mainly rural roads, tracks, trails, paths and footbridges, and in some cases rural waterways. An inefficient transport system can act as a significant constraint on agriculture in rural areas, both by raising the costs and effectiveness of inputs in the production process and by delaying the sale of harvested crops. In Africa, increases in agricultural output in some areas were accomplished by increasing the supply of intermediate means of transportation, which increased access and reduced costs of key inputs (Airey, 1992). Additional evidence on the role of non-motorized transport, particularly bicycles, in the transportation of agricultural commodities is to be found in a study in Uganda (Grisley, 1995).

Rural children in developing countries face many problems in getting to and staying in school. The relationship between distance and schooling is particularly critical in rural areas where children must walk long distances to reach widely dispersed schools. While studies have shown that social and economic factors contribute to high drop out rates in rural areas, lack of public

transportation and inability to pay for private transportation has led many rural children to abandon schooling after a few years (Vasconcellos, 1994).

Nonfarm employment provides a large share of the income of the rural poor. But the development of nonfarm employment is often linked with infrastructure development. Rural enterprises are often located in the areas where there is good access to roads, electricity, and telecommunication facilities (Fan and Chan-Kang, 2004). Good infrastructure also provides opportunities for farmers to migrate to urban centers.

Several studies have demonstrated the direct link between rural infrastructure and rural poverty. Jalan and Ravallion (2002) find that road density has a significant positive effect on the consumption expenditure of rural farm households in poor regions of China. For every 1% increase in kilometers of roads per capita, household consumption increases by 0.08 percent. Research on Vietnam reveals that poor households living in rural communes with paved roads have a 67 percent higher probability of escaping poverty than those in communes without paved roads (Glewwe et al. 2000). Similarly, an evaluation of a World Bank-funded rural road rehabilitation project in Vietnam finds that the strongest positive impact was for poorest households (van de Walle and Cratty 2002). Escobal (2001) analyzed factors that determine market access for poor rural Peruvian farmers, showing the importance of key public assets such as rural roads in lowering transaction costs and in improving incomes of rural farmers.

### **Infrastructure and Poverty: A New Approach**

For the past several decades, there have been many attempts to estimate the impact of public investment (including infrastructure investment) on economic growth and poverty reduction. A significant feature in the literature is that most of the previous studies have only considered one type of government spending or investment at a time. As a result, it is difficult to compare the relative returns to both growth and poverty reduction of different items of spending or investment. Most studies have also used a single equation approach. There are at least three disadvantages with this approach. First, infrastructure investment affects poverty through multiple channels. For example, improved rural infrastructure will not only reduce rural poverty through improved agricultural productivity, but also affect rural poverty through improved wages and non-farm employment. It is very difficult to capture these different effects in a single equation approach. Second, including only one type of public investment in estimating poverty reduction will lead to an upward bias in the estimated impact of that particular investment. Finally, it is difficult to compare the effects of infrastructure investment with other types of investment on both growth and poverty reduction.

In order to systematically assess the impact of different types of public investment on both agricultural growth and poverty reduction, IFPRI has undertaken several case studies that take account of the multiple pathways by which investments can impact on growth and poverty. The underlying conceptual framework is summarized in Figure 1.

Public investment affects rural poverty through many channels. It increases farmers' income directly by increasing agricultural productivity, which in turn reduces rural poverty. Indirect impacts come from higher agricultural wages and improved nonfarm employment opportunities induced by growth in agricultural productivity. Increased agricultural output due to public investment often yields lower food prices, again helping the poor indirectly because they are often net buyers of food grains. In addition to its productivity impact, public investment directly promotes rural wages, nonfarm employment and migration, thereby reducing rural poverty. For example, improved road access helps farmers set up small rural nonfarm businesses such as food processing and marketing enterprises, electronic repair shops, transportation and trade, and restaurant services.

Public investments in rural sectors not only contribute to growth, employment, and wages in rural areas, but also help the development of the national economy by providing labor, human and physical capital, cheaper food, and markets for urban industrial and service development. Growth in the national economy reduces poverty in both rural and urban sectors. Understanding these different effects provides useful policy insights to improve the effectiveness of government poverty reduction strategies. In particular, it provides information on how public investment can be used to strengthen weak links between poverty reduction channels and, thereby, increase efficiency in refocusing public resources on poverty reduction. More efficient investment targeting has become increasingly important in an era of macroeconomic reforms in which governments are under pressure to reduce budgets.

To capture all these various pathways, the IFPRI studies use a simultaneous equations approach to model agricultural production, rural wages, nonfarm employment, agricultural prices, and the relationships between government spending and physical stocks of public capital, considering the lead and lag effects of various investment. The model is estimated econometrically using time series data at sub-regional levels for case study countries. Once estimated, the model can be used to calculate the marginal impacts of additional units of investment in different types of infrastructure, human capital, and technology. The results from three country case studies are summarized below to demonstrate the kinds of results obtained.

### *India*

Poverty in rural India has declined substantially in recent decades; from about 60% of the population in 1970 to about 25% today. This steady decline in poverty was strongly associated with agricultural growth, particularly the Green Revolution, and with expansion of rural nonfarm activities. Both increased in response to massive public investments in agriculture and rural infrastructure. An IFPRI study by Fan et al. (2000) used state level data from 1970 to 1993. The results show that additional government expenditure on roads is found to have the largest impact on poverty reduction and the second largest impact on productivity growth (Table 3). It is a dominant "win-win" strategy. Agricultural research and rural education also have large poverty reducing impacts and favorable growth returns.

In another study, Fan and Hazell (1999) estimated the returns of various public investments in different regions of India using district level data. The districts were classified into three categories: irrigated, high-potential rainfed, and low-potential rainfed. Using district-level data for 1970–95, an econometric model was estimated to measure the impact of different types of public investments on agricultural production and rural poverty in each of these three types of areas. For all types of investment, the highest marginal impact on agricultural production and poverty alleviation occurs in one of the two rainfed lands, while irrigated areas rank second or last. Moreover, many types of investments in low-potential rainfed lands give some of the highest production returns, and all except education have some of the most favorable impacts on poverty. In particular, government investments in roads in low potential rainfed areas have the largest return among all three zones. In terms of poverty reduction, every additional kilometer of roads would lift 1.57 poor people out of poverty in irrigated areas, but would lift 3.5 and 9.51 people out of poverty in high and low potential rainfed areas, respectively. In the past the Indian government has biased its investments towards the irrigated and better rainfed areas. Some correction in favor of the poorer regions would now be win-win for growth and poverty reduction.

### *China*

China has been very successful in reducing its rural poverty during the past two decades; the number of poor falling from 250 million in 1978 to 29 million in 2001. Contributing to this success were a series of policy and institutional reforms, promotion of equal access to social services and production assets, and public investments in rural areas. Yet, as China's economy continues to grow, it is becoming harder to reduce poverty and inequality further. How the government can better design its policies, particularly public investment policy, to promote growth while reducing poverty and regional inequality is hotly debated in both academic and policy circles.

Using provincial-level data for 1970–97, Fan et al. (2002) estimated a simultaneous equations model to quantify the effects of different types of government expenditure on growth and poverty reduction. The results (Table 4) show that government spending on rural infrastructure (roads, electricity, and telecommunications) had substantial impacts in reducing poverty, owing mainly to improved opportunities for nonfarm employment and increased rural wages. However, these impacts were not as large as from investments in education and agricultural R&D. Disaggregating the analysis into different regions reveals that, for all types of government spending, the poverty reducing impacts were highest in the west (the least-developed region), while impacts on agricultural production growth were the highest in the central region (more developed region) for most types of spending. Furthermore, investments in the western region led to the greatest reductions in regional inequality for all types of government spending, while investments in either the coastal or central regions worsened existing regional inequalities.

However, the above study involved highly aggregated types of investment. This high aggregation may mask important differentials even within the same type of investment. For example, within roads, different types may have different impacts on growth as well as on poverty reduction. For this reason, Fan and Chan-Kang (2004) developed an analytical

framework to estimate the effects of different types of roads on growth and poverty reduction in China by using provincial-level data for 1982-1999. The study differs from the previous study in two aspects: first by differentiating by different quality of roads, and second by expanding the measured impacts from just rural areas to both rural and urban areas.

The most significant finding of this study is the high returns from low quality roads, which are mostly rural roads (Tables 5 and 6). The marginal impact from lower quality road investments is more than 4 times greater than that of high quality roads. Even in terms of urban GDP, the return from low quality roads (or rural roads) was greater than that of high quality roads. While high quality roads do not have significant impact on agricultural GDP, low quality roads can generate more than 1.48 yuan worth of agricultural GDP for every yuan invested. Investment in low quality roads also generates high return in rural nonfarm GDP. Every yuan invested in low quality roads yields more than 5 yuan of rural nonfarm GDP. In terms of urban poverty reduction, the impact from low quality roads is larger than the corresponding impact from high quality roads. Likewise, the effects of low quality roads on rural poverty reduction are larger than those from high quality roads.

Another significant finding of the study is the trade-off between growth and poverty reduction when investing in different parts of China. Road investments often yield their highest economic returns in the eastern and central parts of China, while they have their greatest poverty impact in western China. Within the western region, the returns from road investments on growth and poverty reduction are larger in the southwest region, one of poorest regions in China, than in the northwest region.

### *Uganda*

Uganda has made great strides toward economic growth and poverty reduction since the late 1980s. In the 1990s annual GDP growth averaged 6.9 percent per year, up from only 3 percent per annum during the 1980s. As a result, the share of the population below the poverty line fell from 56 percent in 1992 to 35 percent in 1999. This rapid poverty reduction over such a short period is rare, not only in Sub-Saharan African countries but across the developing world. This success, however, was not equally distributed among regions or between rural and urban areas. The incidence of poverty in rural areas was 39 percent in 1999/2000, while it was only 10 percent in urban areas. As a result, the majority of the poor in Uganda (95 percent) are now concentrated in rural areas, with agriculture as their primary source of livelihood.

Public investments have played a key role in these changes, and their impact has recently been quantified in an IFPRI study by Fan, Zhang, and Rao (2003). They used district- and household-level data for 1992, 1995 and 1999 to estimate a multiple equations system structured after Figure 1.

The results reveal that government spending on agricultural research and extension improved agricultural production substantially. This type of expenditure had the largest measured returns to growth in agricultural production. Agricultural research and extension spending also has the largest assessed impact on poverty reduction. Government spending on rural roads also had

substantial marginal impact on rural poverty reduction. The impact of low-grade roads such as feeder roads is larger than that of high-grade roads such as murrum and tarmac roads. Education's effects rank after agricultural research and extension, and roads. Government spending on health did not show a large impact on growth in agricultural productivity or on poverty reduction, in part because of difficulties in measuring some of the impacts of this type of investment. Additional investments in the northern region (a poor region) contribute the most to reducing poverty. The poverty-reduction effect of spending on infrastructure and education is particularly high in this region. However, it is the western region (a relatively well-developed region) where most types of investment have highest returns in terms of increased agricultural productivity. Unlike India and some other Asian countries, these results show that the highest returns are still to be had from investing in high potential areas. Nevertheless, investments in more marginal areas do give very favorable benefit/cost ratios, and they have the largest impact on poverty reduction.

### **Institutions and Infrastructure**

The previous sections have highlighted the importance of investments in rural infrastructure and other key public services for achieving growth and reducing poverty in rural areas. The challenge for many developing countries is to find more effective ways to pay for additional public investments, and to develop suitable institutional arrangements for their delivery. In this section, we discuss the kinds of institutional reforms that could increase efficiency in the delivery of infrastructure services, and the potential role of the private sector.

The public sector is the dominant supplier of infrastructure services in most countries. Inefficiencies are widespread and arise from endemic problems with poor staff incentives and a lack of financial autonomy, accountability and transparency.<sup>3</sup> Privatization can be an effective way to improve efficiency. Private firms have a stronger incentive to build and run infrastructure industries in cost effective ways, and to be more responsive to the end user needs. Privatization also encourages and facilitates the imposition of cost-covering tariffs or user fees, thus addressing the problems of underpricing that have afflicted many publicly provided infrastructure services. Greater efficiency and cost recovery allows firms to make investments and provide services that might not otherwise have been possible. They simultaneously improve efficiency and the government's fiscal condition by making available the same quality and quantity of service with smaller budgetary subsidies. But privatization is not the panacea. Policy makers need to consider both the efficiency and equity implications when deciding what and how to privatize.

“Unbundling” is a necessary part of privatization. Unbundling involves the separation of different activities, such as service generation, distribution and retailing, and identifying which activities can be subjected to competition. In unbundled industries, competition and regulation become complements rather than substitutes (Table 8). Electric power may be most efficiently

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<sup>3</sup> For the causes of government failures in providing infrastructure service, see Herath and Gulati (2004).

provided when generation, transmission and distribution are separated. Electricity transmission may be a natural monopoly but electricity generation and distribution can be provided on a competitive basis. By isolating the natural monopoly elements of vertically integrated industries, unbundling promotes new entry and competition in segments that are potentially competitive (World Development Report, 1994, 2002). In horizontal unbundling, activities are separated by markets, geography and service category. Telecommunications can be horizontally unbundled into radio based cellular services separate from traditional services or divestiture into a number of producers allowing direct competition.

Table 9 highlights the potential for competition and monopoly in unbundled sectors in the power, irrigation, telecommunications and roads sectors. Technological change can alter these characteristics. In the telecommunications industry, for example, virtually all activities are becoming more and more competitive. Where unbundling is possible, competition and regulation become complements. Policy makers then need to decide whether the operator of the monopoly sector is permitted to participate in the related competitive sector.

In the debate on how to make rural infrastructure investments more pro-poor and productive, another critical issue is centralization vs. decentralization. When the benefits of an infrastructure service are mostly captured locally and there is little scope for economies of scale, as with water supply, road maintenance and urban transit, it is argued that decentralization is the most effective way to deliver services. Recent technological innovations are gradually eliminating the need to centralize infrastructure and reducing the need for services to be provided by monopolistic utilities. An added benefit of decentralization is the participation of users themselves. Community participation in rural infrastructure construction and maintenance is crucial for financial incentives to work efficiently and for instituting a legal framework for such an activity.

Strengthening public institutions that provide public goods and services can also lead to significant cost reductions while improving the quality of services provided. New innovations may be needed. For example, increased donor support of key public sector investments could be provided through new financing arrangements that empower the users of public services (e.g. vouchers, user fees and some co-financing mechanisms) and with appropriate institutional reforms to improve mandates and performance. There is also need to form new partnerships between the public, private and NGO sectors for the provision of public services. Even though government must pay for many of these goods and services, it does not mean that the public sector has to deliver them. Recent years have seen considerable success in using NGOs and CBOs to deliver targeted assistance to the poor, and private firms can be contracted to build and maintain schools, health centers, roads and the like. Contracting out arrangements with other parties can be much more cost effective, and may offer better possibilities for involving local people and communities. The types of partnerships desired will vary by sector and function, with many more opportunities to diversify supply arrangements for education and health services, for example, than provision of rural roads and market regulation.

Effective public institutions also require an adequate supply of trained people, including agricultural policy advisors, agricultural researchers and extension workers, business managers, and financial and computer experts. Past investments in training did help increase the supply of some types of key personnel, despite the fact that many did not return from overseas training. But HIV/AIDS, ageing, and low salaries and morale within public institutions have contributed to chronic staff shortages in many countries.

### **Conclusions**

Infrastructure and rural services are central to agricultural development. Improved infrastructure and rural services not only expand opportunities for growth, but also help ensure that such growth is more diffused and equitable. Many developing countries, especially in Africa, still have woefully inadequate levels of rural infrastructure and human capital, and this is a major constraint to their development. Despite this importance, many governments and donors have slashed their levels of investment in rural areas in recent years. It is clear that a “business as usual” approach cannot reach the target of halving the number of poor by 2015. This paper has shown that this trend is misguided; many public investments in rural areas give very favorable rates of return in Asia and in Africa. Moreover, they also make important contributions to reducing rural poverty. Investments in rural roads, together with agricultural research and rural education, are some of the best win-win investments, contributing the most to both agricultural growth and rural poverty alleviation. It has also been shown that targeting more investments towards less-favored areas could also be a win-win strategy in many countries, particularly those that have already invested heavily in their higher potential areas. Moreover, feeder roads or low-cost rural roads give higher returns than higher-level roads in terms of agricultural production and poverty reduction.

Governments and donors need to increase their investment in rural infrastructure, technology and human capital, especially in Africa. These investments are essential for the successful agricultural transformation of these countries. There is also scope for doing better with existing levels of public investment by targeting more precisely the available funds towards investments that are win-win for growth and poverty alleviation. But developing countries also need to improve the efficiency with which most of their public goods and services are supplied. This will require institutional reforms, new forms of financing arrangements, and partnerships with the private and NGO sectors. Since developing countries vary widely in their levels of economic development and in the capacities of their government agencies at different levels, appropriate degrees of centralization/decentralization and private sector participation have to be determined.

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**Table 1: Composition of Total Expenditure (percent)**

	Africa		Asia		Latin America	
	1980	1998	1980	1998	1980	1998
Total	100	100	100	100	100	100
Agriculture <sup>a</sup>	6.0	5.0	15.0	10.0	8.0	3.0
Education	12.0	16.0	14.0	20.0	16.0	19.0
Health	3.0	5.0	5.0	4.0	4.0	7.0
T&C	6.0	4.0	12.0	5.0	11.0	6.0
Social Security	5.0	3.0	4.0	3.0	19.0	26.0
Defense	12.0	10.0	18.0	11.0	7.0	7.0
Other <sup>b</sup>	55.0	57.0	33.0	47.0	35.0	32.0

Notes: T&C stands for transportation and communication.

<sup>a</sup> Includes agriculture, forestry, fishing, and hunting.

<sup>b</sup> Includes fuel and energy; mining, manufacturing, and construction; general administration.

Sources: Calculated using data from International Monetary Fund's *Government Finance Statistics* (various issues).

**Table 2: Infrastructure Expenditure**

	1995 international dollars, billions			Percentage of GDP		
	1980	1990	1998	1980	1990	1998
<b>AFRICA</b>	7.62*	5.54	7.58	1.86	1.05	1.10
<b>ASIA</b>	53.45	41.60	63.93	2.20	0.88	0.76
<b>LAC</b>	23.73	10.08	17.60	1.92	0.72	0.90
<b>TOTAL</b>	83.54	57.22	89.10	2.09	0.86	0.81

Notes: \* indicates number for 1982.

Source: Calculated using data from International Monetary Fund's Government Financial Statistics Yearbook (various issues).

**Table 3: Returns to Rural Investment, India State-level Analysis**

	Returns in Rupee Per Rupee Spending	No. of Poor Reduced Per Million Rupee Spending
R&D	13.45	84.5
Irrigation	1.36	9.7
Roads	5.31	123.8
Education	1.39	41
Power	0.26	3.8
Soil and Water Conservation	0.96	22.6
Health	0.84	25.5
Anti-poverty Programs	1.09	17.8

Notes: Marginal returns are calculated for 1993.

Sources: Fan, Hazell, and Thorat, 2000.

**Table 4: Returns to Rural Investment in China, Provincial-level Analysis**

	Coastal	Central	Western	Average
<b>Returns to Agricultural GDP</b>	<i>yuan per yuan expenditure</i>			
R&D	8.6	10.02	12.69	9.59
Irrigation	2.39	1.75	1.56	1.88
Roads	1.67	3.84	1.92	2.12
Education	3.53	3.66	3.28	3.71
Electricity	0.55	0.63	0.4	0.54
Telephone	1.58	2.64	1.99	1.91
<b>Returns to Poverty Reduction</b>	<i>no. of poor reduced per 10,000 yuan expenditure</i>			
R&D	1.99	4.4	33.12	6.79
Irrigation	0.55	0.77	4.06	1.33
Roads	0.83	3.61	10.73	3.22
Education	2.73	5.38	28.66	8.8
Electricity	0.76	1.65	6.17	2.27
Telephone	0.6	1.9	8.51	2.21
Poverty loan	0.88	0.75	1.49	1.13

Notes: Marginal returns are calculated for 1997.

Sources: Fan, Zhang, and Zhang, 2002.

**Table 5: Returns in GDP to Road Investment, China**

	High Quality	Low Quality
	<i>(yuan per yuan)</i>	
<b>Returns in Total GDP</b>		
Average	1.55	5.99
Northeast	1.35	3.61
North	1.48	6.11
Northwest	1.13	1.44
Central	1.71	6.57
Southeast	1.61	18.63
Southwest	1.91	7.47
South	1.29	7.57
<b>Returns in Urban GDP</b>		
Average	0.99	3.53
Northeast	0.95	2.33
North	0.97	3.70
Northwest	0.69	0.81
Central	0.90	3.18
Southeast	1.07	11.45
Southwest	1.05	3.78
South	0.88	4.78
<b>Returns in Agricultural GDP</b>		
Average	N.S	1.48
Northeast	N.S	0.64
North	N.S	1.26
Northwest	N.S	0.45
Central	N.S	2.50
Southeast	N.S	2.85
Southwest	N.S	3.23
South	N.S	1.77
<b>Returns in Rural Nonfarm GDP</b>		
Average	0.65	5.34
Northeast	0.51	2.38
North	0.63	4.74
Northwest	0.45	1.19
Central	0.85	7.97
Southeast	0.75	15.01
Southwest	0.54	5.39
South	0.51	6.21

Note: Except returns in agricultural GDP to high quality roads, all estimates are statistically significant at the 10% level.

Sources: Fan and Chan-Kang (2004).

**Table 6: Returns in Poverty Reduction to Road Investment in China**

	High Quality	Low Quality
	<i>(number per 10,000 yuan)</i>	
<b>Returns in Urban Poverty Reduction</b>		
Average	0.05	0.19
Northeast	0.11	0.30
North	0.03	0.12
Northwest	0.15	0.19
Central	0.05	0.21
Southeast	0.01	0.15
Southwest	0.11	0.40
South	0.01	0.03
<b>Returns in Rural Poverty Reduction, Official Data</b>		
Average	0.08	1.12
Northeast	0.04	0.36
North	0.07	0.97
Northwest	0.28	1.30
Central	0.05	0.64
Southeast	0.01	0.32
Southwest	0.40	5.70
South	0.02	0.45
<b>Returns in Rural Poverty Reduction, Xian and Sheng data</b>		
Average	0.31	5.67
Northeast	0.14	1.46
North	0.52	8.61
Northwest	0.59	3.39
Central	0.35	7.20
Southeast	0.10	4.70
Southwest	1.01	22.18
South	0.08	2.16

Note: All estimates are statistically significant at the 10% level.

Sources: Fan and Chan-Kang (2004).

**Table 7: Marginal Returns to Government Investment in Rural Uganda**

Investment	Central	East	North	West	Uganda
<b>Benefit–cost ratio</b>					
Agricultural R&D	12.49	10.77	11.77	14.74	12.38
Education	2.05	3.51	2.10	3.80	2.72
Feeder Roads	6.03	8.74	4.88	9.19	7.16
Murram Roads	n.s.	n.s.	n.s.	n.s.	n.s.
Tarmac Roads	n.s.	n.s.	n.s.	n.s.	n.s.
Health	1.37	0.92	0.37	0.96	0.90
<b>Number of poor people reduced per million shillings</b>					
Agricultural R&D	21.75	66.31	175.52	48.91	58.39
Education	3.57	21.60	31.38	12.62	12.81
Feeder Roads	10.51	53.85	72.82	30.49	33.77
Murram Roads	4.08	11.88	14.80	9.77	9.70
Tarmac Roads	2.59	13.12	62.92	9.39	9.73
Health	2.60	6.15	5.95	3.46	4.60

Sources: Fan, Zhang and Rao (2004).

**Table 8: Feasibility of Private Sector Delivery**

Sector/type of service	Potential for competition	Characteristics of good/service	Potential for cost recovery	Equity concerns	Marketability index
Telecommunications					
Local services	medium	private	high	medium	2.6
Long distance	high	private	high	few	3.0
Power					
Thermal generation	high	private	high	few	2.6
Transmission	low	club	high	few	2.4
Distribution	medium	private	high	many	2.4
Gas production/ transmission	high	private	high	few	3.0
Transport					
Rural roads	low	public	low	many	1.0
Primary/secondary Roads	medium	club	medium	few	2.4
Irrigation					
Primary/secondary networks	low	club	low	medium	1.4
Tertiary (on farm)	medium	private	high	medium	2.4

Source: World Development Report ,1994

**Table 9: Unbundling and the Degree of Competition**

Industry	Generation/ storage	Transmission	Distribution/retailing
Power / energy	Competitive	Monopolistic	Competitive
Large scale irrigation	Monopolistic/ oligopolistic	Monopolistic	Competitive
Medium scale irrigation	Competitive	Monopolistic	Competitive
Small scale irrigation	Competitive	Monopolistic	Competitive
Telecommunications	Competitive	Monopolistic	Competitive
Rural roads	Monopolistic		

Sources: Hearth and Gulati (2004)

**Figure 1: Effects of Public Investment on Poverty Reduction**

