Transport and Economic Performance
A Survey of Developing Countries

Cavelle D. Creightney
RECENT WORLD BANK TECHNICAL PAPERS

No. 162  Replogle, Non-Motorized Vehicles in Asian Cities
No. 163  Shilling, editor, Beyond Syndicated Loans: Sources of Credit for Developing Countries
No. 164  Schwartz and Kampen, Agricultural Extension in East Africa
No. 165  Kellaghan and Greaney, Using Examinations to Improve Education: A Study in Fourteen African Countries
No. 166  Ahmad and Kutcher, Irrigation Planning with Environmental Considerations: A Case Study of Pakistan's Indus Basin
No. 167  Liese, Sachdeva, and Cochrane, Organizing and Managing Tropical Disease Control Programs: Case Studies
No. 168  Barlow, McNelis, and Derrick, Solar Pumping: An Introduction and Update on the Technology, Performance, Costs and Economics
No. 169  Westoff, Age at Marriage, Age at First Birth, and Fertility in Africa
No. 170  Sung and Troia, Developments in Debt Conversion Programs and Conversion Activities
No. 171  Brown and Nooter, Successful Small-Scale Irrigation in the Sahel
No. 172  Thomas and Shaw, Issues in the Development of Multigrade Schools
No. 173  Byrnes, Water Users Association in World Bank-Assisted Irrigation Projects in Pakistan
No. 174  Constant and Sheldrick, World Nitrogen Survey
No. 175  Le Moigne and others, editors, Country Experiences with Water Resources Management: Economic, Institutional, Technological and Environmental Issues
No. 177  Adams, The World Bank's Treatment of Employment and Labor Market Issues
No. 178  Le Moigne, Barghouti, and Garbus, editors, Developing and Improving Irrigation and Drainage Systems: Selected Papers from World Bank Seminars
No. 179  Speirs and Olsen, Indigenous Integrated Farming Systems in the Sahel
No. 180  Barghouti, Garbus, and Umali, editors, Trends in Agricultural Diversification: Regional Perspectives
No. 181  Mining Unit, Industry and Energy Division, Strategy for African Mining
No. 182  Land Resources Unit, Asia Technical Department, Strategy for Forest Sector Development in Asia
No. 183  Nájera, Liese, and Hammer, Malaria: New Patterns and Perspectives
No. 184  Crosson and Anderson, Resources and Global Food Prospects: Supply and Demand for Cereals to 2030
No. 185  Frederiksen, Drought Planning and Water Efficiency Implications in Water Resources Management
No. 186  Guislain, Divestiture of State Enterprises: An Overview of the Legal Framework
No. 187  De Geyndt, Zhao, and Liu, From Barefoot Doctor to Village Doctor in Rural China
No. 188  Silverman, Public Sector Decentralization: Economic Policy and Sector Investment Programs
No. 189  Frederick, Balancing Water Demands with Supplies: The Role of Management in a World of Increasing Scarcity
No. 190  Macklin, Agricultural Extension in India
No. 191  Frederiksen, Water Resources Institutions: Some Principles and Practices
No. 192  McMillan, Painter, and Scudder, Settlement and Development in the River Blindness Control Zone
No. 193  Braatz, Conserving Biological Diversity: A Strategy for Protected Areas in the Asia-Pacific Region
No. 194  Saint, Universities in Africa: Strategies for Stabilization and Revitalization
No. 195  Ochs and Bishay, Drainage Guidelines
No. 196  Mabogunje, Perspective on Urban Land and Land Management Policies in Sub-Saharan Africa
No. 197  Zymelman, editor, Assessing Engineering Education in Sub-Saharan Africa

(List continues on the inside back cover)
Transport and Economic Performance
A Survey of Developing Countries

Cavelle D. Creightney

The World Bank
Washington, D.C.
AFRICA TECHNICAL DEPARTMENT SERIES

Technical Paper Series

No. 122 Dessing, Support for Microenterprises: Lessons for Sub-Saharan Africa
No. 130 Kiss, editor, Living with Wildlife: Wildlife Resource Management with Local Participation in Africa
No. 132 Murphy, Casley, and Curry, Farmers' Estimations as a Source of Production Data: Methodological Guidelines for Cereals in Africa
No. 135 Walshe, Grindle, Nell, and Bachmann, Dairy Development in Sub-Saharan Africa: A Study of Issues and Options
No. 141 Riverson, Gaviria, and Thriscutt, Rural Roads in Sub-Saharan Africa: Lessons from World Bank Experience
No. 142 Kiss and Meerman, Integrated Pest Management and African Agriculture
No. 143 Grut, Gray, and Egli, Forest Pricing and Concession Policies: Managing the High Forests of West and Central Africa
No. 161 Riverson and Carapetis, Intermediate Means of Transport in Sub-Saharan Africa: Its Potential for Improving Rural Travel and Transport
No. 165 Kellaghan and Greaney, Using Examinations to Improve Education: A Study in Fourteen African Countries
No. 179 Speirs and Olsen, Indigenous Integrated Farming Systems in the Sahel
No. 181 Mining Unit, Industry and Energy Division, Strategy for African Mining
No. 188 Silverman, Public Sector Decentralization: Economic Policy and Sector Investment Programs
No. 194 Saint, Universities in Africa: Stabilization and Revitalization
No. 196 Mabogunje, Perspective on Urban Land and Urban Management Policies in Sub-Saharan Africa
No. 197 Zymelman, editor, Assessing Engineering Education in Sub-Saharan Africa
No. 199 Hussi, Murphy, Lindberg, and Brenneman, The Development of Cooperatives and Other Rural Organizations: The Role of the World Bank
No. 203 Cleaver, A Strategy to Develop Agriculture in Sub-Saharan Africa and a Focus for the World Bank
No. 208 Bindlish and Evenson, Evaluation of the Performance of T&V Extension in Kenya
No. 209 Keith, Property Tax: A Practical Manual for Anglophone Africa
No. 214 Bonfiglioli, Agro-pastoralism in Chad as a Strategy for Survival: An Essay on the Relationship between Anthropology and Statistics
No. 218 Mohan, editor, Bibliography of Publications: Technical Department, Africa Region—July 1987 to December 1992
No. 225 Dia, A Governance Approach to Reforming Civil Service in Sub-Saharan Africa
No. 226 Bindlish, Evenson, and Gbeitbouo, Evaluation of T&V Based-Extension in Burkina Faso

Discussion Paper Series

No. 82 Psacharopoulos, Why Educational Policies Can Fail: An Overview of Selected African Experiences
No. 83 Craig, Comparative African Experiences in Implementing Educational Policies
No. 84 Kiros, Implementing Educational Policies in Ethiopia
No. 85 Eshiwani, Implementing Educational Policies in Kenya
No. 86 Galabawa, Implementing Educational Policies in Tanzania

(List continues on the next page)
Discussion Paper Series (continued)

No. 87  Thelejani, Implementing Educational Policies in Lesotho
No. 88  Magalula, Implementing Educational Policies in Swaziland
No. 89  Odaet, Implementing Educational Policies in Uganda
No. 90  Achola, Implementing Educational Policies in Zambia
No. 91  Maravanyika, Implementing Educational Policies in Zimbabwe
No. 132 Fuller and Habte, editors, Adjusting Educational Policies: Conserving Resources while Raising School Quality
No. 147 Jaeger, The Effects of Economic Policies on African Agriculture: From Past Harm to Future Hope
No. 175 Shanmugaratnam, Vedeld, Massige, and Bovin, Resource Management and Pastoral Institution: Building in the West African Sahel
No. 181 Lamboray and Elmendorf, Combatting AIDS and Other Sexually Transmitted Diseases in Africa: A Review of the World Bank’s Agenda for Action
No. 184 Spurling, Pee, Mkamanga, and Nkwanyana, Agricultural Research in Southern Africa: A Framework for Action
No. 211 Weijenberg, Dioné, Fuchs-Carshé, Kéré, and Lefort, Revitalizing Agricultural Research in the Sahel: A Proposed Framework for Action
This paper has been prepared as part of the Sub-Saharan Africa Transport Program (SSATP). It reviews the literature on transporting effects on the economic performance of developing countries as well as identifying policy implications. Financial Support was provided by the Government of Denmark. The report was prepared by Cavelle Creightney, consultant, under the direction of Jean Doyen, Division Chief and Ian Heggie, Principal Infrastructure Economist, Africa Technical Department (AFTES). Special mention is made of Prof. Richard Arnott, Boston College, Massachusetts; Profs. David Hensher and W. G. Waters II, Institute of Transport Studies, University of Sydney, Australia; and Prof. C. A. Nash, Director, Institute for Transport Studies, University of Leeds, United Kingdom who provided valuable written comments. Detailed internal reviews were also provided by M. Dick, C. Kessides, M. S. Parthasarathi, and M. Rouis.
FOREWORD

Infrastructure’s interactions with and importance to the economies of developing countries have not been fully understood. This is evident in the Bank’s approach to sector work in infrastructure and in its structural adjustment programs, which emphasize adjusting prices to the detriment of a country’s infrastructure. Still, the available evidence indicates that in poorer countries with inadequate infrastructure, imperfect markets, and a lack of capital, the aggregate supply elasticity of agriculture to non-price factors, such as public goods and services, is substantially greater than the response to prices. Research and policy analysis are needed to understand the way in which infrastructure affects economic performance and to examine how this should be taken into account in our policy interventions, both in infrastructure sectors and in overall macroeconomic management.

The Sub-Saharan African Transport Program (SSATP) is trying to help governments in Sub-Saharan Africa improve their transport policies and programs and enhance the effectiveness and efficiency of the transport sector. It helps governments of Sub-Saharan Africa define much needed policy reforms and assists with their implementation.

This document is the first SSATP publication which addresses the relationship between transport and economic performance and considers the implications of these linkages for sector policy. It reviews the existing literature on the linkages between transport and economic performance in developing countries and identifies some areas where our policy interventions need rethinking. The paper’s findings should provide the basis for developing policies which are fully aware of the role of transport and other infrastructure investments in promoting economic development.

Kevin Cleaver
Director
Technical Department
Africa Region
### ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Full Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTRA</td>
<td>Advisory Committee on Trunk Road Assessment</td>
</tr>
<tr>
<td>BOP</td>
<td>Balance of Payments</td>
</tr>
<tr>
<td>CBD</td>
<td>Central business district</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
</tr>
<tr>
<td>K</td>
<td>Kwacha</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Cooperation and Development</td>
</tr>
<tr>
<td>Tsh</td>
<td>Tanzanian Shillings</td>
</tr>
<tr>
<td>USAID</td>
<td>United States Agency for International Development</td>
</tr>
<tr>
<td>VOC</td>
<td>Vehicle operating costs</td>
</tr>
</tbody>
</table>
ABSTRACT

The Bank's approach to sector and structural adjustment operations has largely ignored the crucial role of transport in improving a country's economic performance and the human well-being of its population. Nevertheless, available evidence shows that many infrastructure interventions are more important than prices in achieving a supply response. Before designing appropriate policy interventions, it is necessary to understand the way in which transport interacts with the economy. This paper surveys the literature for developing countries and points out areas in which policy would be affected.

Transport may have an impact on productive activity in a variety of ways. In the case of rural agricultural production, a transport improvement may lower input prices and hence production costs, improve access to credit, facilitate technological diffusion, increase the area of land under cultivation, or increase the availability of "incentive" goods. Other benefits from a transport improvement may include increased trade and competition from imports, in turn leading to improved production efficiency, downward pressure on consumer prices and reduced seasonal price fluctuations. Stronger social and economic linkages between rural and urban areas and increased non-farm employment may also develop. In the case of urban economic activity, the quality of the transportation and other types of infrastructure seem to be a significant factor in firms' location decisions. Transportation costs are a significant component in total costs, affecting the survival of small firms and the entry of new firms into a market.

Since the time spent travelling (or the distance travelled), is a variable in the individual utility function, the cost and quality of the transport system affects individual leisure and access to public services and facilities. Transport also interacts with the housing market affecting housing prices, and conditions in the housing market affect the demand for transport. Transport also affects the efficiency of the labor market and labor participation rates. The linkages between transport and trade are also examined, and good transport seems to be essential for competing in the modern global economy. Also, the costs of inefficient transport on the economy can be onerous. With the debt crisis, it is imperative to consider the impact of transport sector operations on the government's overall fiscal balance. Evidence is presented to suggest that this can be substantial.

To conclude, the paper examines the implications for transport project appraisal and for structural adjustment. Project appraisal as currently practiced often omits a number of the crucial costs and benefits of a project, often for good reasons of inadequate data. This leads to economic rates of return which are biased. A method of project appraisal which is more comprehensive in identifying and considering all the relevant costs and benefits is required to improve project selection. Also, structural adjustment should take account of its effects on the provision of infrastructure services and should examine the likely impact of the state of a country's infrastructure on the effectiveness of the program.
INTRODUCTION

The World Bank's transport lending policy has evolved rapidly over the past twenty years.\(^1\) Traditional support for standard investment projects has gradually declined as the Bank has moved toward supporting government's sub-sector and sector-wide development plans. Increased emphasis on policy reform also leads to the introduction of structural adjustment operations to facilitate more effective macroeconomic adjustment. However, the approach to both sector and structural adjustment operations has largely ignored the crucial role of transport, despite substantial evidence that good quality transportation infrastructure and reliable services are necessary for improving economic performance and human well-being. Policy interventions should take this into account; however, before appropriate policy can be designed, a better understanding of the interactions between transport and the economy is required. This paper is essentially a literature survey aimed at enhancing our understanding of the role of transport in the economic performance of developing countries, and at identifying the implications for policy.

In theory, transport\(^2\) can affect the economy through a variety of mechanisms. We will distinguish between output linkages (linkages arising from the flow of transport services out of the sector) and input linkages (linkages arising from the flow of resources into the sector which are required to produce transport services). On the output side, transport is linked to the economy in two main ways. First, transport enters as an intermediate input into the production process, either directly in production or as a complement to other factors (for instance, by securing inputs and getting outputs to markets). Thus, the price and quality of transport affects the output of existing firms as well as the decision of potential firms concerning whether to enter an industry. Transport can also serve to attract inputs from other regions, thus shifting the potential aggregate output of the region outward. National output would also increase if inputs shift to more productive uses. Second, transport can either be a final output for consumers, for example social and leisure trips, or a derived demand in order to access locales of income generating activities, consume other goods and services (including health care and education), and enjoy leisure and social activities. These output linkages mean that transport can affect rural and urban productive activities, regional development, rural-urban linkages, trade, the functioning of markets, personal welfare, and efforts to alleviate poverty.

On the input side, inputs in the production of transport services are directly linked to the economy. First, the fiscal and other financial resources used can have an impact on the government budget and on capital markets. In both instances, the resources available for other uses, including foreign exchange resources, can be affected. Second, labor, management, and other human resource inputs can have a direct impact on employment and incomes. This could be significant and beneficial in areas with un/under-employment. On the other hand, if there is a labor shortage, then this could further constrain the resources available for other uses. Finally, investment in infrastructure leads to an increase in aggregate demand and in the output/expenditure of the economy, with resulting multiplier effects.

The literature reviewed below provides evidence of strong linkages to production, trade, and to the welfare of the final consumer. There is also evidence that transport projects and the sector as a whole can have a sizeable effect on the public budget. This paper is organized as follows: Section I discusses a number of methodological issues which arise in analyzing the linkages between transport and production. Section II reviews the literature on the linkages between transport and production. The direct effects of transport on production are distinguished from the indirect effects which occur through the adjustment of prices, technology diffusion, and the impact on credit.
demand and availability. The impact on rural development through the strengthening of rural-urban linkages is also discussed. The section ends with a number of caveats concerning the impact of transport on production. Section III shifts the focus to how transport affects personal welfare. Transport affects the time spent travelling in carrying out other activities and also the flexibility of an individual in choosing a residence and a job. Transport also affects an individual's or community's access to public facilities as well as the operation of the labor and housing markets. Section IV looks at the evidence concerning the role of transport in international trade. Section V turns to the input linkages and looks at the public finance effects of the transport sector. The paper ends with a discussion of the policy implications in Section VI.
I. ANALYZING TRANSPORT-PRODUCTION LINKAGES

The literature on the linkages between transport and the economy in developing countries is thin. Most work is confined to developed countries, and analyzes the impact of public investment on aggregate demand and output. Nevertheless, the work reviewed below highlights several analytical issues which ought to be addressed when discussing these linkages. Much of the work on developing countries has ignored to one or other of these issues.

First is the question of causality. Does transport lead to growth or does transport develop in response to the demand for transport as a consumption good or as an input into production? The question is important for interpretation of results and for policy makers. However, much of the work reviewed below has paid little or no attention to establishing the direction of causation. Econometric analysis tells us that there is a correlation between transport and output; without specific tests for causality, we do not know whether transport leads to an increase in output or whether productive activity, or the potential for it, created pressures for increased transport infrastructure and services. It is certainly plausible that transport could help generate productive activity, in turn creating political pressure for further improvement of transport and generating public revenues to help finance it.

Some studies have tried to deal with these issues, in particular Binswanger et al. and Evans. In their work on agricultural output and investment in India, Binswanger et al identify several potential relationships, occurring simultaneously, which affect investment and production decisions. One of these is that greater private profitability of agriculture in "well-endowed" regions induces farmers to press government for increased investment in supportive infrastructure. Governments are likely to invest more in infrastructure in regions where opportunities or the pressure are greatest.

Similarly, Evans (p. 91) points out that "lagging" regions are not likely to attract public investment but "intermediate" ones might. This realization has lead to a shift in policy thinking on the provision of infrastructure. Traditionally, infrastructure has been regarded as an instrument for leading development in the right direction. However, as Evans points out, such an approach often results in wasted investments, unless the underlying conditions for potential economic growth are favorable. Evans, therefore, argues that public infrastructure investments should follow growth to where it is already occurring or to where there is strong potential.

Second is the question of crowding out or crowding in. On average does public infrastructure investment crowd out private investment or does it encourage private investment? Or because of long gestation periods does the first effect occur initially and the second happen subsequently? Crowding out could occur for a variety of reasons: the demand for scarce physical, human and financial resources for infrastructure investments could raise their prices and reduce the amounts available for private investment. However, the contraction in private investment would be less in a situation of unemployment or underemployment and greater in a situation of institutional and cultural bottlenecks preventing an increase in the supply of resources to meet the extra demand. On the other hand, crowding in could occur through the multiplier process (by creating a demand for privately produced intermediate goods) as well as by improving the enabling environment for the production of unrelated goods and services. Blejer and Khan point out that there is no a priori reason to believe that public infrastructure and private investment are necessarily substitutes or complements. However, their analysis of
developing countries concluded that public infrastructural investment was complementary to private investment.

A number of other questions require careful consideration and analysis. First, since there are more than one policy instruments available to be used singly or in combination, policy makers will require an indication of the relative importance of transport vis-à-vis other instruments such as prices, taxes/subsidies and exchange rates. Second, the role of transport differs according to the type of productive activity and the stage in the development process, and this needs to be specified more clearly. Third, the mechanisms through which transport affects production need to be more clearly understood. For example, does transport influence output directly or does it influence production indirectly by, say, enhancing the responsiveness of production to prices or by reducing various transaction costs of doing business? The following section reviews the available literature on the linkages between transport and production.
II. IMPACT OF TRANSPORT ON PRODUCTIVE ACTIVITY

There are two analytical approaches which have generally been used to understand the relationship between transport and productive activity. The first is the conventional production theory approach in which there is a relationship between the stock of transport infrastructure and output via a neo-classical production function. Here there are three possibilities: (i) transport has a direct impact on production. This section can enter as a direct input into the production reviews evidence on urban production, rural production, and on the international investment decisions of multinational firms.

The second approach uses a spatial model of productive activity, which provides an analysis of how transport determines the location and level of production by determining the "area of influence" and the yield. Production occurs at a point (x,y). Export requires two types of travel, from (x,y) to a road, and along the road to the port or point of sale. Producer prices are given by the difference between the export price at the port and the cost of transportation. This approach enables analysis of a rich set of alternatives regarding the organization, cost, and availability of transport as well as marketing arrangements and how they affect producer prices and the incentives facing producers.

The production theory and the spatial approaches are not incompatible and could even be unified. For now, however, choice should be based on the set of issues of interest. The literature reviewed below has by and large adopted the production theory approach, either explicitly or implicitly, without any obvious rationale. One weakness has been that the way in which transport enters the production function has often not been made explicit.

DIRECT EFFECTS

Much of the literature suggests that transport has a direct impact on production. This section reviews evidence on urban production, rural production, and on the international investment decisions of multinational firms.

Urban production

A 1988 survey of Nigerian manufacturing firms found that the overwhelming response to public infrastructure deficiencies was for the firms to provide their own services, usually at a substantially higher average cost because of the scale of the economies involved. Of the firms surveyed, 15 percent provided their own passenger transport services for workers as a response to the long waiting times at bus stops. The share of these vehicles in total capital equipment was 5.5 percent for small firms and just under 2.8 percent for large firms. In the shipment of goods, 63 percent of firms had their own vehicles. These vehicles made up 11 percent of total capital equipment for small firms but only slightly more than 4 percent for large firms. The average capital value of these vehicles was 387,000 naira (US$51,600) for each firm. Capital expenditures such as radio equipment and motorcycles for couriers were small compared to other infrastructure services such as generators and boreholes, but returns to these investments were extremely high. About 37 percent of firms had radio equipment and its share in the total value of machinery and equipment was nearly three times higher for small firms. The extent of private infrastructure provision despite the higher costs of doing so indicated the importance of having reliable infrastructure inputs.
The costs were particularly high for small firms, and further inefficiency resulted from the duplication of capacity that already existed to some degree in the public sector but was inoperational. Often, these deficiencies lead to a reduction of output. The survey found that firms which relied on publicly provided services or which provided their own services were often forced to reduce their output when either public or private service broke down. In the case of transport, small firms were particularly susceptible since it was too costly to pursue an alternative response. As a result, many small firms in Nigeria have either shut down or have failed to grow to any critical level.

At the industry level, infrastructural deficiencies can act as an entry barrier, reducing industry supply. Studies of Seoul and Bogota have shown that city centers with good infrastructure facilities can serve as "incubators" for the growth of new industrial enterprises, particularly small- and medium-sized firms which cannot afford the capital cost of providing their own infrastructure. Cities with poor infrastructure are unable to provide this "incubator" function, thus constraining industrial growth. A study of Thailand found that most of the small manufacturing establishments were located in the high density areas of Bangkok where, despite the higher rents, they benefitted from readily available externalities including various infrastructure. These central areas in Bangkok were found to play an important role in promoting the birth of small firms. However, as growth and expansion occurred, space and infrastructure constraints become more significant, and there was a clear pattern that firms tended to move outward. It was found that as one moved from the center to the outermost area of the city, the proportion of the smallest category of firms declined from 82 percent to 46 percent while the proportion of the larger size firms (50 - 199 persons) rose from 6 percent to 19 percent. Essentially, the infrastructural conditions in Bangkok were inadequate and constrained the growth of small firms. In the case of transport, heavy traffic congestion and long waiting periods at bus stops caused delays for workers. Hence, firms typically provided bus services for employees' commuting and housing for workers. The average traffic speed in Bangkok throughout the day varies from 13 - 16 kilometers per hour, raising delivery times. This is close to the lowest level found in other major cities. A similar incubator role for infrastructure has been observed in Nigeria and in the northeastern states of India.

Transport can also have various externality effects which affect the productivity of the firm. For instance, unreliability in services and high traffic volumes increases labor force commuting time and causes uncertainty in arrival times. Hamer finds that despite the fourfold expansion in the physical size of Kinshasa since independence, infrastructure continues to deteriorate, and people living in districts developed after 1960 have to walk long distances to reach a bus or their work place. This has also been observed in Nigeria, where about 60-80 percent of staff spend 1-2 hours daily commuting. This affects productivity of workers and the wages they are likely to demand. Savings from employing workers with lower wages are limited by the firms' inability to get them to the workplace on time. The low ratio of self-provision observed in transporting one's own workers in Lagos (15 percent) suggested that a great deal of production time was lost because of the late arrival of workers.

On the other hand, high quality transport services and infrastructure in a particular area can lead to spatial concentration of firms and the benefits of agglomeration.

One study was located which attempted to quantify the impact of public infrastructure on private sector profitability. Shah used data on 34 industries in Mexico for the period 1970-1983 and a measure of public capital which included transport, communications, and the electricity sectors. He reported that: (i) ex-post rates of return to the industrial sector from public investments in infrastructure ranged from 5.5 to 7.3 percent, and were not very different from the returns to private capital; (ii) public infrastructure was weakly complementary to both private capital and labor; and (iii) the
The long run multiplier effect of public infrastructure on output (as measured by the output elasticity of public infrastructure) was positive and significant although very small.

**Rural production**

Several studies show that transport deficiencies can act as a severe barrier to production in rural areas. Riverson identifies two major rural transport gaps facing Sub-Saharan Africa:

- "The rural and feeder roads connecting villages and farming areas to each other and to market centers are usually inadequate, poorly maintained, and costly to use"; and
- "Poor and inadequate rural transport services, caused by the lack of intermediate means of transport (IMTs) and appropriate infrastructure for their use, has meant that the carrying of goods between and within villages and between fields, villages, roads and markets is dependent almost entirely on walking and head- or shoulder-carrying."

Riverson points out that these inadequacies imply enormous (nonmonetary) costs of production and marketing. Added to this the transport requirements for marketing harvested crops, farmers' production costs include the time and energy involved in trekking between home and field. These costs increase rapidly with the distance between village and field and limit production to the fields closer to the village. In addition are the slow and expensive head-loading and poor keeping qualities of most staple food crops in West Africa. Small load sizes mean that the marginal cost of increasing production, in terms of time and energy, is high while the return to labor is small. These factors limit food production to levels considerably below the potential of rural areas. They also constrain efforts to move from subsistence agriculture to produce more marketable surpluses.

Esfahani in a study of aggregate crop production behavior in Egypt found that, whereas aggregate production was rather insensitive to prices, the decline of infrastructure investment explained the slow growth of Egyptian agriculture in the 1970s. Evans reported that in many countries across the Sahel, the absence of rural roads meant that areas with agricultural potential remain under-used. For example, a certain modestly populated region in Eastern Burkina Faso had surplus production of food, yet only 40 percent of the land area was within 10 km of a dirt road passable during the dry season, let alone during the rainy season. In Nigeria, Singh reported the substantial costs on farmers due to inadequate transportation facilities connecting rural areas to market towns. Most farmers had to rely on head portage and bicycles. There were common complaints about high transport charges and insufficient funds to cover the costs of transportation. The lack of access roads meant that some 68 percent of farms had no direct connection to a road. The high cost of transportation in such circumstances effectively wiped out much or all of any gains from sales, providing little incentive to farmers to increase their output.

Several studies examined the relative role of infrastructure vis-à-vis other factors (such as prices, agricultural research, and credit) in influencing agricultural output. Chhibber reported that the aggregate supply elasticity of agriculture in poorer countries was higher with respect to non-price factors than to prices. This suggested that improvements in infrastructure were likely to yield bigger increases in production than a rise in prices. In addition, the response of aggregate supply to prices was likely to be higher in relatively advanced countries like Argentina than in poorer countries like India. The greater infrastructure constraints in Africa therefore suggests an important role for infrastructure and other non-price factors in the recovery of African agriculture.

Binswanger et al analyzed 58 countries for the period 1969 to 1978 in order to determine the role of prices and physical and human infrastructure on agricultural output and factor demand. Supply functions for aggregate crop and livestock output and demand functions for fertilizer and tractors were estimated within
and across countries. The within country estimates showed a clear, positive effect of road density and pavement on all outputs, yield, and input demand. In the case of crop area, the effect of pavement was insignificant. The cross country estimates showed positive coefficients for rural road density and paved roads in all equations.

In another study, Binswanger et al. developed a model which examined the inter-relationships between rural infrastructure (including roads) and a number of other factors and agricultural investment and output. The model was tested with data from 85 districts in India for 1961 to 1981. It was found that roads increased on average by 40 percent between 1971 and 1981, contributing 7 percent to the growth of agricultural output and to fertilizer use over this period. Improved road investment enhanced agricultural output with an elasticity of 0.20. The analysis suggested that the main transmission mechanisms were improved marketing opportunities and reduced transaction costs rather than private investment.

Faini adopted a production theory approach to evaluate the response of agricultural and industrial output to both price policies and public investment in 26 developing countries. It was found that public investment bore a positive and well-determined coefficient in the equation for industry, but was not statistically significant from zero for agriculture. Faini pointed out that the results for agriculture were at variance with the findings of most econometric analyses and advanced three possible explanations. The first possibility was that the correct interpretation of his equations was not "following an increase in public capital stock, agricultural growth will not differ significantly from zero", but "higher public investment will not lead to higher agricultural growth." The second possibility was that the measure of public capital stock used was unduly biased towards industrial infrastructure rather than agricultural infrastructure. The third was that the impact of public investment on agriculture worked both directly by increasing the availability of vital infrastructures, and indirectly by facilitating the supply response to prices. Further tests on the third proposition however yielded little support for it, and the work suggested that further research was needed on the importance of interaction effects between price responses and the availability of infrastructure.

Antle used 1965 aggregate agricultural production data from 47 developing countries and 19 developed countries and an aggregate production function approach to study the effects of transportation and communication infrastructure on aggregate agricultural productivity. The results strongly supported the hypothesis that inadequate transport and communication infrastructure was an important constraint on aggregate agricultural productivity in developing countries. It was also found that inadequate transport and communication infrastructure explained more of the variation in agricultural production than did agricultural research.

**Foreign investment**

One study found that the quality of infrastructure was an important factor in the international investment location decisions of some multinational firms. Wheeler and Mody analyze the location decisions of US multinationals and found that the indices of agglomeration benefit, of which infrastructure quality was one, were highly significant and exerted large, positive impacts on investment. For electronics investment in developing countries, infrastructure quality was dominant. The authors concluded that for countries in the early phases of development, good quality infrastructure was preferable to tax incentives for attracting foreign investment.

**INDIRECT EFFECTS**

Transport infrastructure can influence production indirectly through various mechanisms. This section reviews the evidence on linkages through the price mechanism, technology diffusion, and credit.
Prices

The cost of transport to the user affects the margins between producer and consumer prices, which in turn affects production. Ahmed and Rustagi \(^{27}\) found that the difference between consumer and producer prices in some African countries was up to three or four times larger than in Asian countries, partly due to differences in the level of infrastructure development. Also, Beenhakker \(^{28}\) reported that in developing countries, transport costs made up a substantial part of marketing costs, which in turn made up a substantial proportion of final agricultural prices. It was reported that in several countries, marketing margins varied between 25 and 60 percent of the final price, about half of which was accounted for by transport costs. Thus about 10 to 30 percent of the final price of agricultural products reflected the cost of transport. Ahmed and Hossain \(^{29}\) compared two groups of villages in Bangladesh, one infrastructurally well developed, the other less equipped. It was found that while the price of the major commodity - paddy - differed little, the price of fertilizer was 14 percent lower in the developed villages, and the price of labor was 12 percent higher. While these price differences did not affect the use of labor much, the developed villages used almost twice as much fertilizer. As a result, output in the developed villages was estimated to be in the range of 31 to 42 percent higher.

Technological diffusion

Infrastructure can be a key factor in the diffusion of modern technology to remote rural areas. Several authors have suggested that improved transport can act as an accessory to agricultural modernization programs that encourage the introduction of mechanization, the use of chemical fertilizers, and high yield varieties. \(^{30}\) Ahmed and Hossain \(^{31}\) studied 16 villages in Bangladesh and found that the diffusion of irrigation-based modern technology in agriculture had been faster in infrastructurally developed than in less developed areas. In order to obtain results which can be generalized, the authors conducted an extensive study of the interactions between rural infrastructure and the diffusion of small-scale irrigation technology in 1,609 villages where the spread of tubewell irrigation was known to be extensive. They found that: (i) villages with difficult access had achieved a much smaller rate of diffusion of tubewell-based irrigation technology than villages with easy or moderate access by motorable road; and (ii) development of infrastructure influenced not only the extent of diffusion but also the maintenance and use of tubewells.

Credit

There is evidence that transport improves access to institutional credit, contributes to shifting the allocation of credit from nonproductive to productive activities, and leads to increased demand for credit. The Ahmed and Hossain \(^{32}\) survey of 16 villages in Bangladesh found that: (i) infrastructure development improved access to institutional credit almost sevenfold, although mainly for landowning households; (ii) the share of moneylenders in total noninstitutional credit was generally larger in infrastructurally developed than in underdeveloped villages as infrastructure development accelerated the growth of mercantile practices, and the process of commercialization expanded informal credit markets; (iii) approximately 37 percent of institutional credit in infrastructurally underdeveloped villages was allocated to directly nonproductive activities, whereas these activities made up only 15 percent of institutional credit in developed villages; and (iv) households in developed villages allocated a share of credit to business almost four times larger than that of households in underdeveloped villages; this was indicative of the increased opportunities for business and trade brought about by infrastructure development.

The work of Binswanger et al \(^{33}\) on India using cross-section time-series data on 85 districts between 1972 and 1980 illustrated that banks were more likely to locate in areas where roads and markets were improving. Roads affected farmer’s incomes, demand for inputs
and hence demand for credit. Also, roads contributed to reducing the riskiness of agricultural investments, reduced banks' repayment problems, and reduced the transaction costs for both customers and banks. Roads were found to have a more powerful effect than markets with an elasticity of 0.83° whereas regulated markets had an elasticity of 0.20°. Furthermore, it was found that the presence of commercial bank branches accelerated the pace of private agricultural investment with a 10 percent increase in the number of banks, leading to a 3 to 8 percent increase in investment in animals and pumpsets. The effect on tractors though was only 1.4 percent and was not significant.

INFRASTRUCTURE
AND RURAL DEVELOPMENT

Several studies indicated that roads and transport services, through their impact on rural production and on trade between regions, affected the social and economic linkages between town and country. An inadequate network inhibits rural production and trade, limits the growth of income earning opportunities, and spurs out-migration among job-seekers. However, reduced transport costs from better roads make it possible for larger firms in distant locations to compete more effectively in local markets.

Infrastructure affects the availability of "incentive goods" such as nonagricultural consumption goods. These enter rural areas in quantities proportional to the purchasing power and can create incentives for increased agricultural production. Hazell and Roell observed that poorly developed infrastructure in the Gusau region of Nigeria impeded farm household access to nonfood goods and services, and increased their cost relative to the price of food. This reduced the incentives for production of cash crops and for trade.

Binswanger found that road improvements in Thailand contributed to an expansion of the area of land under cultivation (especially in the lower north of the country), a concentration on cash crops rather than subsistence crops, and an increase in rice exports from remoter regions. The resulting lower transport costs largely accounted for a sharp decline in home-weaving, and other subsistence-oriented nonfarm activities. However, there was increased processing and transport of cassava and other commodities which were then exported from the regions.

In Lismayo, Somalia, road improvements lead to a decline in the number of licensed manufacturing businesses from 248 to 147, particularly among tailors and makers of wood and metal products. However, the total number of businesses increased nearly 50 percent, particularly among the retail, trading, and transportation sectors. Part of this increase was attributed to increased trade with other areas which followed the road improvements.

In Bangladesh, better infrastructure had a positive impact on the marketing of agricultural produce. Although the average yearly prices of paddy and rice were similar in two groups of villages compared, the seasonal variations were higher in the infrastructurally underdeveloped villages. This was partly a reflection of the poorer access and greater difficulties in trading produce with other areas. Households in the developed villages also tended to purchase a greater share of basic foods in the marketplace: 34 percent of rice compared to 29 percent in underdeveloped villages, and 72 percent of vegetables and tubers compared with 56 percent. Farming was more commercialized in the developed villages: farmers marketed 47 percent of their paddy output compared to only 35 percent in the less developed villages.

In Colombia, with the improvement of rural roads in areas previously inaccessible to vehicles, travel times fell to a fifth or sixth and transport costs fell to one fifth and lower, leading to a dramatic reduction in the costs of marketing agricultural produce. Farmers increased production of goods for market, particularly perishables. Output levels often rose substantially: 50 percent for peas in one
area, 200 percent for potatoes and wheat in others. The local price of fertilizers fell sharply, encouraging greater use. Easier access to nearby towns enabled more farmers to take advantage of credit offered by banks and lenders, and more workers to obtain alternative jobs in nonfarm activities. The latter caused an increase in wage levels and earnings. There was even some return migration by farmers who previously had not been able to work their farms profitably. **38**

**SUMMARY AND CAVEATS**

We have presented evidence from several studies supporting the hypothesis that transportation infrastructure and services are critical for productive activity in developing countries. But what analytical techniques and data have been used in these studies and how robust are the results? A thorough investigation of this question is beyond the scope of this paper; nevertheless a few observations may be made. Methodologically, the studies can loosely be grouped into three: econometric analyses, documentation and description of trends determined from data, and reviews of literature and/or country-level experience, sometimes with theoretical analysis. (Table 1 provides a list of the studies cited above and an indication of their objectives, methods of analysis and data). A few of the studies utilized both the second and third methods. Most of the econometric studies were concerned with modeling production or productivity with the inclusion of an infrastructure variable. One problem common to these studies was finding a suitable measure for infrastructure. The way in which this is addressed affects the interpretation of results and our conclusions about the role of infrastructure. Another observation is that a number of the studies were not directly concerned with examining transportation and production linkages, yet these linkages became apparent from the research.

The evidence presented above suggests several mechanisms through which transport may have an impact on productive activity. In the case of rural agricultural production, a transport improvement may lower input prices and hence production costs, improve access to credit, facilitate technological diffusion, increase the area of land under cultivation, or increase the availability of "incentive" goods. Other benefits from a transport improvement may include increased trade and competition from imports, in turn leading to improved production efficiency, downward pressure on consumer prices, and reduced seasonal price fluctuations. Stronger social and economic linkages between rural and urban areas and increased non-farm employment may also develop. In the case of urban economic activity, the quality of the transportation and other types of infrastructure appear to play a significant factor in firms' location decisions. Transportation costs have been found to be a significant component in total costs, affecting the survival of small firms and the entry of new firms into a market.
# TABLE 1: Studies on the Linkages between Transport and Production

<table>
<thead>
<tr>
<th>Study</th>
<th>Purpose</th>
<th>Analysis and data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1: Econometric analyses</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shah (1990)</td>
<td>Examines, among other questions, the impact of public investment on private sector profitability and the limiting factors in private output expansion.</td>
<td>Estimates a restricted cost function with data from Mexico for 34 industries from 1970-1983. Public capital stock is measured from aggregate data on electricity, communications, and transportation.</td>
</tr>
<tr>
<td>Ahmed and Hossain (1990)</td>
<td>Identifies, describes and measures the effects of rural infrastructure (transport and roads) on agricultural production and other factors.</td>
<td>To separate the effects of infrastructure from other variables, the authors: (i) compare relevant variables for villages grouped according to their degree of infrastructure development (descriptive); and (ii) use econometric techniques.</td>
</tr>
<tr>
<td>Binswanger, Yang, Bowers and Mundlak (1987)</td>
<td>Examines the role of prices and public inputs on agricultural supply and factor demand.</td>
<td>Supply functions for aggregate crop output and aggregate livestock output and demand functions for fertilizer and tractors are estimated using cross-country data from 58 countries for 1969-1978. The explanatory variables include a measure of physical infrastructure based on road density, pavement and agroclimatic potential.</td>
</tr>
<tr>
<td>Binswanger, Khandker and Rosenzweig (1989)</td>
<td>Quantifies: (i) the relationships among the investment decisions of farmers, government and financial institutions, and (ii) the effects of these decisions on agricultural investment and output.</td>
<td>Cross-section data for the different variables are taken from 85 randomly drawn districts of India for 1960/61-1981/82. &quot;Government infrastructure&quot; consists of primary schools, canal irrigation, rural electrification, regulated rural markets, and total road length. The effects of government infrastructure, banks and prices on fertilizer demand and aggregate crop output, as well as other relationships, are estimated.</td>
</tr>
<tr>
<td>Faini (1991)</td>
<td>Examines the impact of adjustment lending and, in particular, price policies and infrastructure availability, on agriculture.</td>
<td>A translog specification of a revenue function with 3 sectors (agriculture, industry, and services) and 3 factors (labor, private, and public capital) is estimated with panel data from 26 developing countries for 1976-1985.</td>
</tr>
<tr>
<td>Antle (1983)</td>
<td>Examines the effects of transportation and communications infrastructure on aggregate agricultural productivity.</td>
<td>A Cobb-Douglas production function where aggregate agricultural production is a function of land, labor, livestock, and fertilizer consumption is estimated using data from 47 less developed countries and 19 developed countries for 1965. Each country’s Hicks-neutral productivity level is specified as a function of education, research, and infrastructure.</td>
</tr>
<tr>
<td>Hazell and Roell (1983)</td>
<td>Examines the relationships between income and consumption for different commodities and commodity groups and examines how these change with the income and socio-economic characteristics of the households. Based on two case studies of Muda in north-west Malaysia and Gusau in northern Nigeria.</td>
<td>Engel relations are estimated using household expenditure data obtained from samples of households which directly benefitted from World Bank agricultural projects in the 2 regions.</td>
</tr>
</tbody>
</table>
Study | Purpose | Analysis and data
--- | --- | ---
### Group 2: Documentation and description based on data


**Lee (1989)** | Explores employment location in Bogota and Cali in order to provide analytical tools to better assess the impact of urban policies and investment programs in developing countries. Focusses on documenting the trends in location patterns of employment, on analyzing the components of those trends such as the location patterns of newly established and relocating firms, and on modeling the location decisions of individual firms to understand how the responses of individual firms collectively result in the observed trends. | The study relied on various micro-level data bases for data on establishments, households, and employment location. |

**Lee (1985)** | Part of a World Bank research effort to study the impacts of spatial policies intended to decentralize economic activity from large urban centers. The paper documents the observed changes and trends in the location patterns of manufacturing employment in the Seoul region, examines the degree of effectiveness of various policy instruments implemented in the region, and makes conclusions regarding the desirability of decentralization policies and the implied welfare losses resulting from such spatial policies. | The research relied on the annual manufacturing survey data for 1973-1981 plus special surveys conducted for the project. |

**Esfahani (1987)** | Studies the behavior of country-wide aggregate indicators of agricultural performance (crops) for Egypt. | Indices of aggregate production, aggregate price level, factor shares and total agricultural employment were constructed in order to depict a broad view of the developments in Egyptian agriculture. The Tornqvist-Theil indices are used as they are reasonable approximations to the aggregate "true" indices. |

**Singh (1986)** | Documents the infrastructural problems facing Nigerian farmers in marketing their agricultural produce. | Based on description of data. |

**Ahmed and Rustagi (1987)** | Measures and compares spatial price spreads, intertemporal price gaps and regional price differences in selected African and Asian countries and attempts to identify the underlying causal factors and hence corrective policies. | Price spreads were decomposed to identify the causal factors underlying the price differences. This helped to identify strategic policy variables and measure the extent to which farm prices can be raised and consumer prices lowered by changes in market institutions. |

### Group 3: Reviews of the literature and/or country-level experience

**Hamer (1986)** | Reviews the urban productive sector as a vehicle for achieving macroeconomic goals and the links between this sector and the economy as a whole. | Based mainly on experiences from Sub-Saharan African and other cities. |

**Riverson and Carapetis (1991)** | Reviews the current situation with regard to rural transport and its impact on rural development in Sub-Saharan Africa. | The author's contention that deficient transport is an important constraint to the response of food supply to demand changes is based on the experience of the World Bank in rural transport projects in Sub-Saharan Africa. They point out, however, that quantification of these constraints will require additional research. |
Study Purpose

Group 3: Reviews of the literature and/or country-level experience (continued)

Beenhakker (1987) Analyzes the effects of: (i) various government policies (exchange rate, foreign exchange regime, prices, subsidies, marketing, entry into trucking industry) on the transport and agricultural sectors, and (ii) government interventions in one of these sectors on the performance of the other.

Carmemark, Sets out a general approach for the economic analysis of rural road projects. Biderman and Argues that quantification of road user savings is unsuitable for rural roads and it is preferable to focus on the mechanisms by which transport cost savings are translated into increased agricultural production and income. Questions analyzed are: who benefits from transport cost savings? how will producers respond? and what constraints exist to the materialization of the full developmental impact of a road?


Chhibber (1988) Reviews literature and evidence from developing countries on the aggregate supply response to agriculture.

Binswanger (1983) Tries to establish: (i) the factors explaining the growth in rural nonfarm employment and its dependence on agricultural growth; and (ii) the benefits that poor rural areas derive from rural nonfarm employment and measures, if any, that can be taken to accelerate its growth as a means to alleviate rural poverty.

Anderson and Vandervoort (1982) Evaluates the effectiveness and impact of USAID’s rural road projects. This is based on eight impact evaluations in Latin America/Caribbean, Africa, and Asia carried out between July 1979 and September 1980.

Analysis and data

The paper combines theoretical analysis, descriptive data, policy experience at the country level, and literature reviews in order to understand the impact of government policies on transport and agriculture and the impact of interventions in one sector on the other.

Theoretical analysis and a review of experience with rural road projects are the basis of the proposed approach to the economic analysis of such projects.

Review of literature and experiences from developing countries.

Review of the literature and experiences from developing countries. Also provides elasticities from other studies including the author’s own.

World Bank Sector Study.

Effectiveness was determined by comparing actual length of road constructed, cost, and time required with the projections made, and by the degree of sustainability of the project’s activities (maintenance and construction) after disbursement of project funds. Impact was measured by the degree to which broader goals were attained such as increased agricultural production and income or improved quality of rural life, as well as other effects, whether or not intended.
As mentioned in Section I, it is important to maintain a balanced view of the role of transport vis-à-vis other policy variables. To quantify this would require further research, and none of the studies reviewed attempted to do this. It seems, however, that what is required is not quantification but instead specification of the problem and analysis of how the relevant policy instruments may be used to tackle it. However, we may wish to note here that the actual supply response to any transport improvement may be constrained in a number of ways such that transportation investments do not have their intended effects. First, the incidence of transport costs determines how the benefits of a transport improvement are shared between the producer and other economic agents, namely transporters, middlemen, and consumers. The benefits accruing to the producer is what will affect the actual response of the producer. Second, the existence of other non-transport constraints to production will affect how producers respond to transportation improvements. Possible constraints include a lack of other resources, "wrong" risk preferences and attitudes, or a lack of storage facilities, irrigation, extension services, and credit. The latter factors are particularly important under conditions of low economic activity. The first bank-assisted highway project in Botswana is an example of the importance of such constraints. Third, initial conditions are important in determining producer response. For example, the relative importance of transport cost savings will depend on the level of economic activity, declining as we move from high activity to low activity levels. Likewise, transport improvements will be more important during the early stage of the commercialization of agriculture than at a later stage when other factors play a more important role. Fourth, improved transport infrastructure can lead to a substitution of one activity for another, rather than a sole increase in one activity. For example, a reduction in transport costs may lead to an increase in the relative net producer prices of cash crops vis-à-vis those of subsistence crops, leading to a switch away from subsistence production to production for the market. Similarly, improved feeder roads make cultivation of bulky, transport-intensive commodities more economical; and roads which facilitate truck access in place of head-loading may also stimulate production of perishables since lower transport costs and reduced spoilage lead to improved effective net producer prices.
III. IMPACT OF TRANSPORT ON PERSONAL WELFARE

The modal choice model provides an analytical framework for understanding the demand for travel and hence the impact of transport on welfare. Here we will focus on the demand for travel between home and work since most trips, particularly by lower income groups, are for that purpose. In the short run, distance travelled each day is fixed as housing and employment locations are given. In the simple model, an individual maximizes utility by choosing a transport mode subject to time, budget, and possibly interpersonal constraints. There is a tradeoff between time and leisure and money - a faster mode saves time and increases leisure but is more expensive and reduces the consumption of other goods. Other factors influencing modal choice include reliability, flexibility, safety, and comfort. This model predicts that if distance travelled is the same, poor individuals, because they are unable to afford faster modes, spend more time travelling than wealthier individuals.

In the long run, housing and employment locations may also be chosen. There are three possibilities: (i) given a fixed employment location, individuals choose the optimal housing location; (ii) given a fixed housing location, individuals choose the optimal job location; or (iii) simultaneous determination of both job and house. When choosing locations and transport modes, the activities of other members of the household, particularly those who travel, become important. Where there are school-age youths, proximity to schools become an important consideration. Where women have substantial activities in addition to regular work, such as child care, housework, and community management, then travel choices and the time spent travelling affect the extent of social interaction, the sharing of household tasks, and the time available for parental control and supervision.

Within these parameters, individuals maximize utility by choosing a bundle of goods, including "distance," subject to a budget constraint. The location decision entails trading off the monetary and nonmonetary costs of commuting with the cost of housing or the earnings from a particular job. An extension of the model interprets the distance term in terms of leisure time. Utility is maximized over leisure and goods subject to a budget and time constraint. Location equilibrium occurs when the decreased housing costs or higher earnings of a longer commute are offset by the increased costs of foregone leisure.

The transport system, as well as conditions in the housing and labor market, has an important bearing on the flexibility of individuals in making these choices and hence on welfare as determined by leisure time, consumption of other goods and services, and access to public services. For instance, cultural and societal arrangements in certain African contexts imply that the bulk of farm, household, and community activities are carried out by women who as a result bear a heavy transport burden. In Tanzania, for example, women accounted for more than 70 percent of total transport time and ton-kilometers carried. The quality of transportation therefore affects the time spent travelling and hence the overall time constraint, particularly for women. There are therefore profound implications on welfare through affecting accessibility to various public services, ability to accept income-generating opportunities, and ability to accomplish the various productive, household, and community tasks required.

ACCESSIBILITY AND TRANSPORT

"Accessibility" refers to the ability or ease of reaching various destinations or places offering opportunities for a desired activity. A broader
definition will account for load-carrying effort as well as the monetary costs involved. In the rural context, Barwell et al.\textsuperscript{45} distinguish three levels of accessibility relevant to welfare: (i) accessibility of basic needs or local accessibility (such as food production and preparation, collection of water and cooking fuel, acquisition of agricultural and domestic inputs, local marketing of produce, and health and education); (ii) accessibility of wider needs through access to major centers of activity (incorporating beneficial activities which are less essential for survival); and (iii) personal movement or travel for non-essential purposes.

The authors continue to postulate several potential welfare effects of improved access. First, improving local accessibility can affect welfare through enabling consumption and production and through saving time. For example, improved access to water supply will increase the consumption of water and improved access to farm lands may result in increased agricultural production. Also, improved accessibility often results in shortening the time required to carry out a particular activity. The time saved may be devoted to other activities or to leisure, thus improving welfare. Second, improved access to meet wider needs through access to major centers of activity has welfare effects in the areas of agricultural productivity and marketing, and through the provision of central services such as hospital care and credit facilities. Finally, improved personal travel, enabling contact with friends and relatives and participation in social and cultural events, brings a social benefit in terms of improved quality of life. It is also likely to bring an economic benefit through increased information flows on prices and greater mobility of labor and other inputs, thus increasing market efficiency. The awareness of technological developments is also increased. Barwell et al. provide a comprehensive review of the welfare effects of improved access.

Given the spatial location of facilities and activities which determines the required distance, transport becomes critical to ensure access. In principle, the use of any means of transport, other than walking or headloading, improves accessibility by reducing time taken and/or increasing the unit load that can be carried. Access is also improved through telecommunications and mail, but transport is required to provide the physical presence necessary in most situations. It is important to emphasize that both infrastructure and the transport modes and aids that use the infrastructure are necessary for accessibility. In rural areas, infrastructure refers to the feeder roads that connect the rural areas to the country's main road networks and the tracks, trails, and paths that provide local access to those feeder roads. Transport modes may be motorized (motor vehicles), non-motorized (bicycles and animal-drawn carts), or may include a variety of "intermediate" means of transport. In urban areas, infrastructure refers to the highways and urban road network, and the modes are primarily motorized, including private cars, public buses, taxis, and motorcycles. Non-motorized modes are often very important, such as walking and cycling. The task for policy makers will be to provide the appropriate combination of infrastructure and travel modes/aids that will meet the transportation needs of urban and rural populations.

A number of studies have pointed to the importance of transportation for access to public services and facilities. Kahnert\textsuperscript{46} points out that the high "costs" of reaching fixed facilities due to poor transportation infrastructure and unreliable services may prevent attendance and cause high dropout rates. As a result, programs to promote primary education, vocational training and health sometimes need to devise more appropriate delivery systems in order to reach the target group. This is particularly so for illiterate workers and small entrepreneurs who face even higher opportunity costs in attending full-time, traditionally run training schools. As a result, mobile training courses held in the evenings and in the neighborhoods where the trainees reside have, on balance, been more successful. In Bangkok, for example, more than 60 percent of the students initially attending evening training courses arranged by the Bangkok Metropolitan Administration
through mobile units in slum areas successfully completed the courses. In a competing scheme run by the National Housing Authority, using full-time day courses in fixed locations, dropout rates were as high as 90 percent.

The Ahmed and Hossain study of 16 villages in Bangladesh found that infrastructure had a significant impact on health conditions and on educational attainment. Where health facilities were less accessible, as was the case in the less infrastructurally developed villages, it appeared that female members received less medical care than male members. This gender discrimination disappeared in the more developed villages where medical facilities were more accessible. The authors found, however, that after controlling for the effect of gender, infrastructure still had a positive effect on health.

Transportation can affect both the supply of and demand for education. On the supply side, the development of transport facilities can be a major factor influencing the location of an educational institution, particularly at the secondary level, since students have to be drawn from a number of villages in order to make it viable. On the demand side, a development in transportation facilities is likely to increase the demand for education from households located in remote villages. Also, by increasing the scope for nonfarm employment which may require basic literacy and numeracy, transport developments may increase the demand for education. The Ahmed and Hossain study did not explicitly test these demand and supply relationships but simply assessed the impact of infrastructure on literacy, controlling for other socioeconomic variables which also affect literacy. It was found that the development of infrastructure did not have a significant impact on the literacy rate as this was affected more by size of landholding and gender. However, the primary school drop-out rate for the landless and small landowning groups was earlier in infrastructurally underdeveloped villages.

Given a level of population density, transportation improvements increase the potential number of people a facility in a fixed location can serve. As such, fewer but larger facilities can be built to serve a target population when the number of people served by any one facility is increased. Facilities can thus take advantage of economies of scale and specialization of services. For instance, in Harare, privately operated "emergency taxis" which seat 10 people deviate from fixed routes to drop off passengers and run on flexible schedules. This type of arrangement is well-suited for occasional visits to a public facility.

In developed countries, schools, hospitals, and social service departments operate extensive transport services to make their facilities accessible to target groups and the population they serve. These services are known as "tertiary" public transport and often involve fleets of vehicles.

There is evidence that rural Africa is characterized by inadequate transport and consequently limited access. As a result, inordinate amounts of household time and energy is consumed in carrying out basic tasks requiring transport. Riverson reported that the average total time spent by village households on transport ranged from 1,875 hours a year (for about 80 ton-kilometers in southwest Tanzania, with an average household size of 4.5) to 4,830 hours per year (for about 216 ton-kilometers in study villages in Ashanti, Northern, and Volta regions of Ghana, with an average household size of 11.9). Household transportation, especially for water and firewood, is in fact the major task that competes for household labor time and limits ability to do other things. Internal trips (for water and firewood collection, crop production and marketing, to local market and grinding mill) represented 73 and 80 percent of total time and ton-kilometers spent on transport, respectively, in the Ghana and Tanzania studies. External trips were those to health facilities, external markets, and outside locations.

In a number of African cities, Barrett observed that a persistent "transport supply deficit" restricts access to work and play and increases the time spent on various activities. In
Abidjan, the urban population grew by 60 percent between 1980 and 1990, while the nominal fleet of the main operator - Sotra - had only gone up by 11 percent. In Nairobi, the urban population grew by 44 percent, while the number of passengers carried daily by the two main operators - KBS and Matatus - had risen by 63 percent, and the bus fleet rose by 21 percent. When viewed more generally in terms of the main operators for whom reliable information was available over a significant period of time, it was observed that the fleets available to these operators had declined by 12 percent between 1986 and 1989, while nearly every city analyzed had experienced annual population growth rates of 4 to 6 percent. This inadequate supply of transport undoubtedly limits the access of urban residents and increases the time spent travelling.

TRANSPORT AND THE LABOR MARKET

A closer look at the labor market indicates that transport influences its functioning and can thus have an impact on an individual’s ability to accept income-generating activities. In the short run, residential location and the location of economic activity affects the demand for transport to work. Therefore, the cost and availability of transport infrastructure will affect the labor market participation of individuals according to their time and budget constraints. For instance, the severe time constraints facing women with substantial household duties, discussed earlier, makes accessibility to a place of work a critical factor determining labor market participation. Also, residents of peripheral areas incur high costs to access those locations that residents close to the city can reach easily and cheaply. As a result, they may not seek higher paying jobs in the city center.

For example, when 700,000 squatters were relocated to the outskirts of Delhi between 1975 and 1977, in one resettlement colony, female employment fell by 27 percent while male employment fell by only 5 percent. Increased distance from their former place of employment meant that women could no longer quickly or inexpensively travel to work. They therefore were unable to both work outside of the home and fulfill their domestic responsibilities. Also the high cost of travel relative to their meager earnings meant that working was no longer feasible. Another study which compared two poor neighborhoods in Mexico City, one an inner city slum and one a shantytown on the periphery, found center city residents to be "better situated than residents of the city periphery to adapt to the [1980s] economic crisis". The author does not specifically discuss transport and accessibility but points out that the success of center city residents in the formal and informal sectors was partly due to their "advantageous location".

In addition, transport also affects the efficiency of the labor market. Poor transport infrastructure restricts labor mobility by increasing labor market transaction costs/job search costs. This contributes to segmented labor markets or a coexistence of vacancies and unemployment. Job search costs include the expenditure on transportation and the opportunity cost of time spent travelling to look for a job. Quality and availability of services can also contribute to "psychological costs". Poor transport services increase these job search costs and reduces labor mobility. According to economic theory, a risk-neutral worker will search for a job until the expected discounted benefits of the search exceed the costs of the search. If job search costs are high due to poor transport services, then this could create segmented labor markets where job seekers are unable to respond to vacancies and employers are unable to find workers, thus reducing employment.

In support of this hypothesis, a study of high-school graduates in Britain showed that the type, quality and availability of public transport was an important factor in job search journeys. Despite a wide spatial distribution of job vacancies known to British high-school graduates through employment agencies and newspapers, the actual pattern of job search was concentrated in districts highly familiar to the job seeker and
limited to a small number of known bus routes. In the developing country cities where information about job opportunities is limited (limited to observation or a network of family and friends), this effect might be more severe. A transport system which restricts an individual’s range of travel and hence his/her personal information network restricts the job search area, spatially segments the labor market, and creates inefficiencies in the economy.

TRANSPORT AND THE HOUSING MARKET

The relationships between transport and the housing market are both complex and dynamic and there is no clear direction of causality. On the one hand, conditions in the housing market affect residential location decisions which in turn influence the demand for transport. On the other hand, transportation affects the housing market. Further analytical and empirical work will be needed to clarify these relationships and identify those which are significant. However, a few illustrative examples may be provided.

Analysis of the housing market illustrates that transport infrastructure can act as an important influence on housing prices. A simple model by Mohring illustrates some crucial linkages. Consider a residential community located around a central business district (CBD). Travel costs are directly proportional to the distances involved, and families choose a location so as to minimize travel costs. In equilibrium (when all families are content to stay where they are) the annual rents on two pieces of property will differ by the difference in annual travel costs to the CBD of the two properties. In this model, rents plus travel costs must equal the maximum travel cost that any family has to incur, i.e., the travel costs entailed in living at the city limits. Therefore, at the city limits, rents are low and travel costs are at a maximum; as one moves closer to the CBD, travel costs fall and rents increase; at the CBD, travel costs are a minimum and rents are at a maximum. In such a framework, a transport improvement which leads to a reduction in the travel costs of any distance travelled will lead to a decline in the sum of rents and travel costs (since maximum travel costs are reduced). For residents near the city limits, this decline will be reflected primarily in travel costs. For residents close to the CBD, it will be realized mainly in the form of lower rents since people are able to live further away from the center. Transportation shortages, therefore, may partly be responsible for the high price of housing close, or easily accessible, to the CBD. Likewise, land values tend to increase - sometimes dramatically - in the vicinity of improved transport infrastructure. An assessment of the land market in Jakarta found that, of nine types of infrastructure or services, only three - paved roads, sidewalks and public transportation - were useful predictors of price.

Conditions in the housing market can also impact upon the demand for transport by affecting location decisions. First, the pattern of housing and land prices is a factor in the location decisions of households. As discussed in the two previous paragraphs, price differentials often reflect variations in accessibility to the central business district and are, therefore, affected by the state of transport infrastructure and services. These prices however may also have feedback effects on residential location and hence on the demand for transport. As Krantion points out, poor families who cannot afford legal housing near employment centers or cannot find space in over-crowded center city slums must either squat illegally in the city near employment centers, or move to settlements in the periphery where housing is less expensive. In Lima, for example, squatter settlements stretch up to forty kilometers outside the city, bypassing unoccupied land that is held off the market for speculative reasons.

Second, housing regulations which affect the ability to change residential location can also affect the demand for transport. Krantion points out that regulations such as zoning laws and building codes that control the use of land and the size of housing units can make moving
very difficult. Rent control leads to housing shortages and fierce competition for housing. These regulations mean that once a family obtains housing, there are high transaction costs to moving and housing location is then essentially fixed. This can increase the demand for transport as workers are unable to adjust to job relocation by moving their homes. Finally, traditional land-use patterns may determine the current relative locations of residential, commercial, and industrial areas, including the location of poor residential areas, and hence the demand for transport.
IV. TRANSPORT AND TRADE

Transport is a vital input in the production of tradeables. Poor transport increases transport costs and decreases the incentive to produce tradeables instead of non-tradeables. In the case of international trade, recent developments in industrialized countries mean that efficient transportation is becoming increasingly important if developing countries are to avoid marginalization and to maintain a competitive edge. Accordingly, the quality and efficiency of the transport infrastructure and services is particularly important for the success of a country's trade liberalization policy. In examining the links between trade and transport, we will review some of the trade and transport developments in industrialized countries, discuss the evidence on the importance of efficient transport systems for developing countries' trade performance, and look at some of the figures on the high costs of inefficient transport systems.

TRADE AND TRANSPORT DEVELOPMENTS IN OECD COUNTRIES

The trading and business environment in OECD countries has been characterized by three main developments: (i) rising labor costs in the OECD countries has lead to “global sourcing” where components or whole product lines are imported primarily from developing countries with low labor costs; (ii) markets are increasingly characterized by rapid changes in consumer preferences, leading to demand volatility and shorter product cycles; and (iii) competitive pressures imply the need to reduce the excessive costs of inventories and of obsolescence. These developments mean that international trade and industrial relations increasingly involve business in several countries for the same product, and that manufacturers, wholesalers and retailers are modifying their procurement, production, and marketing provisions to ensure that sales arrangements are closely linked to market demand.

These developments have been made possible by the application of logistics, a management tool which enables quick response to market changes while at the same time reducing costs. Logistics is applied to coordinate the functions of purchasing, production, and marketing so as to obtain the least cost while retaining flexibility for necessary adjustments. The successful application of logistics, however, requires some basic infrastructure, primarily communication networks, transport, and warehousing. For instance, enhanced communication and reliable transportation are needed to maintain minimum inventories; cargo unitization, in particular, containerization, enables faster transport and reduced damage and loss; and multi-modal transport arrangements allow expeditious transfers of consignments from origin to destination.

TRANSPORT AND TRADE PERFORMANCE

The relevance of logistics management for developing countries remains highly debatable. In the case of the least developed economies of South Asia, Latin America, and Sub-Saharan Africa, it is not clear whether the sophisticated technological and institutional requirements can be immediately applied. While there is no data on the precise relationship between improvements in logistics management/transport infrastructure and improved trade performance, there are several indicators that at least in some developing countries the former has been important for the latter. First, there is evidence that logistics management has been important for the success of some developing countries in export markets.
operations, Chile's fruit exports, Colombia's trade with cut flowers, and Kenya's horticultural products are examples. Second, there is systematic evidence that trade policy reforms have been more successful where they were supported by institutional and infrastructural reforms. Country evidence for Malawi, Mexico, and Turkey confirmed that investments in infrastructure had a positive effect on industry profitability and trade performance, particularly where there were sound interconnections with other macroeconomic and sectoral policies.

Third, there are cases where an inability to respond to changing market conditions and customer requirements have lead to a loss of competitive edge. For instance, Indian manufacturing exporters are in danger of losing their market share to other Asian competitors because of deficiencies in infrastructure and time-consuming procedures. India's exports of manufactured goods are targeted primarily at the North American, West European, and Japanese markets. However, importers in these markets operate on very thin inventory margins and thus require supplies to be delivered reliably and within tight time limits. Indian exporters are increasingly unable to meet such requirements. The transport of containers from the point of cargo origin to the loading port exceeds feasible transit times by over 300 percent. Also, the freight rates of delivered Indian export containers in Europe and the USA exceed those of Asian competitors by 30 percent on average. This endangers further growth of manufactured goods exports, either because foreign importers will switch to speedier, more reliable competitors, or because regional competitors will crowd out Indian manufacturers on the basis of transport cost advantages. The reasons for long transit times and high freight rates are rooted in outmoded and inflexible regulations that govern the conduct of trade and transport, lack of coordination between the multitude of government bodies responsible for the organization of transport, and poor performance - by international standards - of the public entities responsible for transport.

Finally, there are numerous examples of how poor transport arrangements can impede the trade performance of developing countries. First, policies toward national flag carriers often stipulate that a considerable proportion of a country's trade must be carried by national carriers. This is often justified on the grounds of preventing excessive payments in scarce foreign exchange to foreign carriers. However, because of the costly and unreliable services provided by such carriers, compared to the efficient and competitive services provided by international carriers, the marketing of national trade becomes unreliable and services have to be subsidized in order to control excessive costs. In fact, payment losses occur as a result of higher ocean freight payments to domestic carriers caused by restricted trade (see Table 2). Often foreign purchasers of exports from such countries insist on making their own shipping arrangements as a condition of purchase, leading to savings of 20-35 percent in their logistics costs. Second, shipping deregulation enhances the competitiveness of a country's trades. Deregulation of Chilean shipping resulted in a reduction in freight rates, which improved competitiveness of Chilean exports vis-à-vis those of other Latin American countries.

Finally, national customs arrangements in some developing countries are one of the most severe impediments to trade. Arrangements often involve outmoded rules and regulations, customs responsibilities extending beyond the function of import verification and duty collection, unclear procedures, bribery, and excessive processing times. Attempts to improve the situation lead some governments to hire cargo inspection services provided by international specialist firms. This occurred in Bolivia, Indonesia, and several Sub-Saharan African countries. However, improvements were less than expected, and it was soon realized that a fundamental reorganization of national customs services was required, with reforms tied to tax and other institutional reforms. Mexico, after having taken this route, experienced major improvements in trade and industrial productivity, as well as improved efficiency of the national customs service.
TABLE 2: Estimated Losses Resulting from Cargo Reservation Systems

<table>
<thead>
<tr>
<th>Country</th>
<th>BOP Gains due to Cargo Reservation (US$ mn)</th>
<th>Proportion of all Seaborne Cargo carried by Foreign Flag Vessels (percent)</th>
<th>Payment Losses due to Cargo Reservation (US$ mn)</th>
<th>Ratio Losses/Gains</th>
</tr>
</thead>
<tbody>
<tr>
<td>Argentina</td>
<td>34</td>
<td>50</td>
<td>98</td>
<td>2.9</td>
</tr>
<tr>
<td>Brazil</td>
<td>50</td>
<td>55</td>
<td>371</td>
<td>7.4</td>
</tr>
<tr>
<td>Chile</td>
<td>5</td>
<td>69</td>
<td>85</td>
<td>17.0</td>
</tr>
<tr>
<td>Colombia</td>
<td>11</td>
<td>50</td>
<td>86</td>
<td>7.8</td>
</tr>
<tr>
<td>Ecuador</td>
<td>8</td>
<td>60</td>
<td>41</td>
<td>5.1</td>
</tr>
<tr>
<td>India</td>
<td>72</td>
<td>58</td>
<td>309</td>
<td>4.3</td>
</tr>
<tr>
<td>Indonesia</td>
<td>40</td>
<td>78</td>
<td>362</td>
<td>9.1</td>
</tr>
<tr>
<td>Malaysia</td>
<td>23</td>
<td>80</td>
<td>480</td>
<td>20.9</td>
</tr>
<tr>
<td>Pakistan</td>
<td>17</td>
<td>85</td>
<td>186</td>
<td>10.9</td>
</tr>
<tr>
<td>Peru</td>
<td>10</td>
<td>60</td>
<td>57</td>
<td>5.7</td>
</tr>
<tr>
<td>Philippines</td>
<td>37</td>
<td>80</td>
<td>224</td>
<td>6.1</td>
</tr>
<tr>
<td>Turkey</td>
<td>28</td>
<td>75</td>
<td>257</td>
<td>9.2</td>
</tr>
<tr>
<td>Uruguay</td>
<td>12</td>
<td>85</td>
<td>61</td>
<td>5.1</td>
</tr>
<tr>
<td>Venezuela</td>
<td>20</td>
<td>70</td>
<td>187</td>
<td>9.4</td>
</tr>
</tbody>
</table>


The evidence seems to suggest that in order to participate in a modern trading environment, developing countries will increasingly require efficient logistics systems in order to avoid marginalization and to maintain their competitive edge. Specifically, developing countries will need to respond quickly to orders and delivery on time.

COSTS OF INEFFICIENT TRANSPORT SYSTEMS

There is evidence that inefficient transport systems can be costly for the economy. A World Bank study of West African transit corridors provides orders of magnitude of the costs incurred with transit traffic flows in the Sahel region. The figures exclude the costs of moving goods for domestic and for regional trade. It is estimated that in 1987, the total direct generalized costs, including ocean shipping costs, for the 337,000 tonnes of transit traffic to and from Mali were approximately US$100 million. The total economic cost for Mali for this transit traffic was roughly 5 percent of 1987 GDP. Similarly, the study estimates that the total costs of Burkina Faso’s international traffic in 1988 were US$133 million or 23 percent of the total value of its imports and exports and 7 percent of its GDP. In Niger the total generalized cost in 1988 for the international traffic was estimated at US$67 million or 3 percent of GDP. These figures
indicate that the costs of transporting goods for international trade are substantial and that there are important savings to be made from having efficient transit systems.

Evidence from Zaire indicates that transport developments go against the tide of multimodal modern transport trends and that the resulting system costs are large. Proximate estimates are provided of the costs of Zaire's logistics system. The cost to the user (direct expenses and capital costs) for imports delivered at Kinshasa (Kinshasa wholesale price) is a weighted average on the order of 1.8 times the price at source (3.1 times in the case of motor fuel). On exports, the average is 1.3 times the original cost. The costs of transport to and from Zaire is 2.1 times that of Mali, another land-locked country. The difference between the total value of Zaire's foreign trade at the point of origin and at the destination is around US$1.7 billion, which is absorbed by the carriers, tax payments, and the various intermediaries. This amount does not include the costs of various commercial and trade practices.
V. THE PUBLIC FINANCE IMPACT OF TRANSPORT

The public provision of transport impacts on the government budget at both the sector level and the project level. The transport sector is linked to the budget through the financial transactions occurring between government on the one hand and the government departments and public enterprises providing transport on the other. A transport project is linked to the budget according to who bears the costs vis-à-vis who reaps the benefits of the project. This section illustrates these linkages and presents evidence to show that they can indeed be sizeable.

FISCAL IMPACT OF THE TRANSPORT SECTOR

The transport sector affects the government budget by way of the financial transactions which occur between the government and the government-owned transport organizations. Government expenditure on transport organizations may include subsidies related to specific activities, subsidies to cover operating losses, equity injections and loans to enterprises. If the government writes off enterprise debt, this too is expenditure equivalent to a capital grant. Government revenue from transport organizations includes user charges (when paid directly to the treasury) and indirect taxes, dividends from government equity in the enterprise, amortization, and interest payments on loans made to the enterprises and profits.

In addition to these explicit transactions, there may also be implicit subsidies to the enterprises not included in the above categories. These may include interest rate differentials favoring the enterprises, costs of exchange rate risk borne by the government, government guaranteed loans where government meets its contingent liability in the event of default, fuel prices below border prices and preferential interest rates received by enterprises on non-government borrowing. These financial transactions mean that the operations of transport organizations have a fiscal impact through the net cash flow to and from government.

Analyses of the transport sector in Tanzania and Zambia estimated the cash flow between government and transport organizations. The authors assembled information from the annual financial statements of the various public agencies comprising the government transport sector and summarized it in tables showing the financial performance of the sector. Data limitations precluded accounting for all explicit and implicit transfers; nevertheless, the partial framework presented showed that the fiscal impact was substantial. In Tanzania, data from the road and civil aviation departments for FY85/86 and FY86/87 indicated that user charges, particularly road user charges, were a major source of government current revenues, accounting for 10-12 percent. On the other hand, expenditures were lower than revenues and accounted for about 6 percent of total current expenditures. As a result, there was a significant surplus of revenues over expenditures, amounting to about 3-5 percent of government current revenues (equivalent to about US$30 million).

Data from the transport enterprises indicated the following: In FY85/86, the enterprises incurred a net loss of Tsh 2,752 million (US$145 million) which improved significantly in FY86/87 to a loss of Tsh 1,889 million (US$37 million). However, in FY85/86, there was little impact on the overall fiscal balance as the enterprises financed their deficits by not paying bills and running down working capital to the extent of Tsh 2,653 (US$140 million). As a result, the net outflow from government was a mere Tsh 127 million (US$7 million). However, working capital cannot be used to finance current operations indefinitely, and in FY86/87 the government had to step in with a
major infusion of equity capital, grants and loans to pay off the short term debts of the enterprises. The government supplied Tsh 4,820 million (US$100 million) in new capital.

The combined results indicated that: (i) when the shortfall of regular maintenance was included, the overall drain on the government’s fiscal revenues rose from 2.5 percent of total current revenues in FY85/86 to 17.4 percent in FY86/87; (ii) when the shortfall of maintenance was excluded (i.e. when the figures relate only to the cash obligations of the government), the overall balance showed a positive figure of 2.1 percent of total current revenues in FY85/86, but still showed a deficit of 7.3 percent in FY86/87.

In Zambia, a quick review of the transport sector revealed one of poor health. In FY91 it imposed a financial burden of about K4,875 million (US$98 million) on government in the form of direct grant requirements, overdrafts in government-owned banks, or government guaranteed short-term debts. This was equivalent to 13 percent of the government’s total current revenues, excluding grants. When shortfalls in regular maintenance were included, (i.e., when erosion of capital is included), the financial burden rose to K6,565 million ($131 million). This was equivalent to 17 percent of the government’s total current revenues. The estimates for FY92 were equally large. The financial burden was K6,243 million ($52 million) without the maintenance shortfall and K10,330 million ($86 million) when it was included. Far from contributing to government revenues, these transport agencies are clearly imposing a major drain on revenues.

The authors of the Tanzania study applied their framework to fourteen additional countries for FY82/83 - FY87/88. Poor data quality limited the analysis, nevertheless the work pointed to a substantial budgetary effect. Ten of the fourteen highway departments made a net contribution to general government revenues and in some cases the contributions were significant; of the 75 transport enterprises or groups of enterprises examined, 26 recorded profits and 49 recorded losses; none of the railways were profitable; airlines, airports and ports showed a roughly even split between profit makers and loss makers. The net cash flow between the transport sector and the government is summarized in Table 3. The calculations of these budgetary flows do not account for any implicit subsidies received by the transport enterprises and therefore underestimates the fiscal impact.

FISCAL IMPACT OF A TRANSPORT PROJECT

The impact of a transport project on the government budget depends on who bears the costs of the project vis à vis who reaps the benefits. In the case of a transport infrastructure project, costs are typically borne by the public sector, whereas benefits accrue to the private sector. The point can be illustrated by considering a typical road rehabilitation project (see Table 4). The cost of the project is US$100 million and has an economic rate of return of 30.7 percent. The rate of return is calculated from quantifiable benefits, namely reduced vehicle operating costs, savings on routine maintenance and savings on avoided future road reconstruction costs. However the project induces other fiscal flows. For example: (i) the reduction in vehicle operating costs leads to a reduction in indirect taxes on vehicle usage, fuel taxes being the most important; (ii) the government must make debt service payments on the loans used to finance the project; and (iii) increased production due to improved transport facilities and increased spending related to the savings on vehicle operating costs lead to increased tax revenues for the government. The example illustrates that under certain assumptions, the combined effect of these project-induced fiscal flows can be a reduction in government revenues of over $17 million per annum, despite the high economic rate of return.
### TABLE 3: Summary of Fiscal Flows To and From Government
(US$ million)

<table>
<thead>
<tr>
<th>Country</th>
<th>Roads</th>
<th>Airports</th>
<th>Ports</th>
<th>Railways</th>
<th>Airlines</th>
<th>Shipping</th>
<th>Bus/Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethiopia</td>
<td>(23.8)</td>
<td>(4.4)</td>
<td>15.4</td>
<td>(3.4)</td>
<td>(5.8)</td>
<td>0.0</td>
<td>-</td>
</tr>
<tr>
<td>Ghana</td>
<td>(59.7)</td>
<td>(2.2)</td>
<td>1.2</td>
<td>(7.7)</td>
<td>3.4</td>
<td>(14.5)</td>
<td>0.0</td>
</tr>
<tr>
<td>Tanzania</td>
<td>(31.4)</td>
<td>(3.3)</td>
<td>17.1</td>
<td>(92.8)</td>
<td>(1.3)</td>
<td>0.0</td>
<td>(1.5)</td>
</tr>
<tr>
<td>Zaire</td>
<td>(43.7)</td>
<td>(0.4)</td>
<td>(0.7)</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>-</td>
</tr>
<tr>
<td>Indonesia</td>
<td>(44.4)</td>
<td>(12.2)</td>
<td>(5.4)</td>
<td>0.0</td>
<td>(296.8)</td>
<td>(112.9)</td>
<td>(6.3)</td>
</tr>
<tr>
<td>Philippines</td>
<td>64.3</td>
<td>(17.7)</td>
<td>0.0</td>
<td>(6.0)</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>173.1</td>
<td>1.5</td>
<td>9.5</td>
<td>(40.3)</td>
<td>0.0</td>
<td>(7.7)</td>
<td>(29.3)</td>
</tr>
<tr>
<td>Thailand</td>
<td>302.1</td>
<td>0.0</td>
<td>8.5</td>
<td>(4.3)</td>
<td>31.7</td>
<td>0.0</td>
<td>-</td>
</tr>
<tr>
<td>Argentina</td>
<td>1,661.7</td>
<td>-</td>
<td>(9.5)</td>
<td>(425.7)</td>
<td>58.2</td>
<td>(14.6)</td>
<td>-</td>
</tr>
<tr>
<td>Colombia</td>
<td>(28.8)</td>
<td>(40.2)</td>
<td>(56.9)</td>
<td>(24.4)</td>
<td>-</td>
<td>0.0</td>
<td>-</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>25.2</td>
<td>(0.1)</td>
<td>0.0</td>
<td>(2.5)</td>
<td>0.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Jamaica</td>
<td>23.6</td>
<td>(5.1)</td>
<td>(0.3)</td>
<td>(3.0)</td>
<td>(4.1)</td>
<td>0.0</td>
<td>-</td>
</tr>
<tr>
<td>Algeria</td>
<td>509.7</td>
<td>9.1</td>
<td>0.0</td>
<td>(182.5)</td>
<td>33.8</td>
<td>12.3</td>
<td>-</td>
</tr>
<tr>
<td>Pakistan</td>
<td>83.1</td>
<td>0.0</td>
<td>0.0</td>
<td>(38.5)</td>
<td>0.0</td>
<td>(16.3)</td>
<td>0.0</td>
</tr>
<tr>
<td>Tunisia</td>
<td>26.8</td>
<td>1.6</td>
<td>1.9</td>
<td>(15.8)</td>
<td>26.8</td>
<td>0.0</td>
<td>-</td>
</tr>
</tbody>
</table>

Notes:
1. Figures generally refer to different years.
2. Local currency amounts converted into US $ at the prevailing exchange rates.
3. Including shortfall of regular maintenance.

This exercise demonstrates that if other macroeconomic effects are excluded from our cost-benefit analysis, then the economic rate of return as a criteria for project selection may be biased. As pointed out by Fischer, even if a project has a high rate of return, the government must capture the additional returns from the investment in order to avoid a negative fiscal impact. To illustrate, Fischer considers a project with the high real rate of return of 15 percent. If the marginal tax rate is 20 percent then the government will receive only 3 percent of the cost of the project in tax revenue. If the government borrows at 7 percent to finance the project, then government bears a net fiscal outflow equivalent to 4 percent of the cost of the project, even though its social yield is 15 percent. Thus the investment still adds to future deficits, despite its high yield.
TABLE 4: Fiscal Impact of a Transport Project

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Benefits¹</th>
<th>Loss of User Revenues²</th>
<th>Debt Service Payments³</th>
<th>Increased Tax Revenues⁴</th>
<th>Net Fiscal Impact⁵</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(50.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>(30.0)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>30.0</td>
<td>(9.3)</td>
<td>(14.0)</td>
<td>6.00</td>
<td>(17.30)</td>
</tr>
<tr>
<td>4</td>
<td>31.5</td>
<td>(9.8)</td>
<td>(14.0)</td>
<td>6.30</td>
<td>(17.50)</td>
</tr>
<tr>
<td>5</td>
<td>33.1</td>
<td>(10.3)</td>
<td>(14.0)</td>
<td>6.62</td>
<td>(17.68)</td>
</tr>
<tr>
<td>6</td>
<td>34.7</td>
<td>(10.8)</td>
<td>(14.0)</td>
<td>6.94</td>
<td>(17.86)</td>
</tr>
<tr>
<td>7</td>
<td>36.5</td>
<td>(11.3)</td>
<td>(14.0)</td>
<td>7.30</td>
<td>(18.00)</td>
</tr>
<tr>
<td>8</td>
<td>38.3</td>
<td>(11.9)</td>
<td>(14.0)</td>
<td>7.66</td>
<td>(18.24)</td>
</tr>
<tr>
<td>9</td>
<td>40.2</td>
<td>(12.5)</td>
<td>(14.0)</td>
<td>8.04</td>
<td>(18.46)</td>
</tr>
<tr>
<td>10</td>
<td>42.2</td>
<td>(13.1)</td>
<td>(14.0)</td>
<td>8.44</td>
<td>(18.66)</td>
</tr>
<tr>
<td>11</td>
<td>44.3</td>
<td>(13.7)</td>
<td>(14.0)</td>
<td>8.86</td>
<td>(18.84)</td>
</tr>
<tr>
<td>12</td>
<td>46.5</td>
<td>(14.4)</td>
<td>(14.0)</td>
<td>9.30</td>
<td>(19.10)</td>
</tr>
<tr>
<td>13</td>
<td>48.9</td>
<td>(15.1)</td>
<td>(14.0)</td>
<td>9.78</td>
<td>(19.32)</td>
</tr>
<tr>
<td>14</td>
<td>51.3</td>
<td>(15.8)</td>
<td>(14.0)</td>
<td>10.26</td>
<td>(19.64)</td>
</tr>
<tr>
<td>15</td>
<td>53.9</td>
<td>(16.7)</td>
<td>(14.0)</td>
<td>10.78</td>
<td>(19.92)</td>
</tr>
<tr>
<td>16</td>
<td>56.6</td>
<td>(17.5)</td>
<td>(14.0)</td>
<td>11.32</td>
<td>(20.18)</td>
</tr>
<tr>
<td>17</td>
<td>59.4</td>
<td>(18.4)</td>
<td>(14.0)</td>
<td>11.88</td>
<td>(20.52)</td>
</tr>
<tr>
<td>18</td>
<td>62.4</td>
<td>(19.3)</td>
<td>(14.0)</td>
<td>12.48</td>
<td>(20.82)</td>
</tr>
<tr>
<td>19</td>
<td>65.5</td>
<td>(20.3)</td>
<td>(14.0)</td>
<td>13.10</td>
<td>(21.20)</td>
</tr>
<tr>
<td>20</td>
<td>68.8</td>
<td>(21.3)</td>
<td>(14.0)</td>
<td>13.76</td>
<td>(21.54)</td>
</tr>
<tr>
<td>21</td>
<td>72.2</td>
<td>(22.4)</td>
<td>(14.0)</td>
<td>14.44</td>
<td>(21.96)</td>
</tr>
<tr>
<td>22</td>
<td>75.8</td>
<td>(23.5)</td>
<td>(14.0)</td>
<td>15.16</td>
<td>(22.34)</td>
</tr>
</tbody>
</table>

EIRR 0.307

Notes:

1. Quantifiable benefits, including reduced VOCs, savings on routine maintenance, and savings on avoided future road reconstruction costs.
2. Calculated using average 1982 tax rates in Tunisia. This represents the loss of fuel tax revenue due to the reduced VOCs.
3. Calculated at 10 percent interest with a two year grace period.
4. Calculated at 20 percent of net benefits. This represents increased tax revenues from increased production and increased spending due to the savings on VOCs.
5. This is the sum of columns (3), (4), and (5), and represents the combined effect of the project-induced fiscal flows.
VI. POLICY IMPLICATIONS

This paper has presented substantial evidence that transport affects a country’s economic performance and the success of its development efforts and does so in ways which are diverse and complex. An efficient and responsive transport sector that is less of a burden on the economy and provides benefits in terms of increased productivity and reduced time costs. Therefore future policy interventions need to be designed with these interactions more clearly in mind. Two areas of policy where this should occur are:

(i) the selection and design of transport projects and the formulation of sectoral policies should be based on a much broader consideration of these interactions; and

(ii) structural adjustment programs should take account of its effects on the provision of infrastructure services and should examine the likely impact of the state of a country’s infrastructure on the effectiveness of the program.

Full operationalization of these conclusions would require much more research and analysis than has been done here. Also, de facto experiment should occur before methods can be refined and standardized. Nevertheless, it is worthwhile to discuss these policies, indicating problems and directions for the future.

Appraisal of transport projects

Traditional project analysis is designed to choose projects which provide the maximum economic benefits from limited resources. In practice, it relies heavily upon the quantification of costs and benefits by valuing them at their shadow prices. The difficulties involved in such quantification are well known and result in economic rates of return based on a restricted set of costs and benefits, typically those to which some value can be associated. The result is that ERRs are often biased upwards or downwards depending on the nature of our project and the impacts not included in the cost/benefit analysis. The Bank’s approach to project appraisal recognizes the conceptual and statistical difficulties involved in quantification but provides little in the way of alternative project selection criteria.

This paper has highlighted several ways in which transport affects the economy, many of which are excluded from project appraisal as presently practiced. For example, the severe fiscal constraints facing many developing country governments make it imperative that the impacts of projects and policies on the public budget are identified. This would require examining the incidence of costs and benefits, and determining a shadow price for public funds. Our discussion illustrated that the fiscal impacts can be substantial yet such considerations are usually left out of project appraisal. Another example is the impact of projects and programs on different groups within the community. The Bank’s concern with poverty alleviation or for the position of disadvantaged minorities or groups (women, etc.) requires us to take into account the distribution of benefits and costs in designing a project. This paper has illustrated ways in which transport improvements can benefit some groups at the expense of others. For instance policies affecting the cost, quality or availability of freight or passenger transport not only benefit the immediate users of those services but have secondary impacts as well. Land-use and land value changes, displacement of the urban poor, labor market participation of females, the distribution of lower production costs between producers, transport firms, and landowners all become important. This paper did not focus on the environmental impacts of transport projects, but it is clear that these are also inadequately dealt with in current project appraisal practices,
and it is precisely in this area where the techniques and evidence needed for quantification are least advanced.

Despite these impacts, traditional project appraisal has been concerned with evaluating the overall size of costs and benefits rather than their distribution. This paper does not propose abandoning project appraisal but suggests that it be supplemented with an approach that relies less heavily on quantification but is more comprehensive in its identification and consideration of all the relevant costs and benefits and the distribution of these costs and benefits. More specifically, it is essential to identify and clarify all the costs and benefits of a project or policy reform and identify the impacts on different groups, even if they cannot be quantified. Since these impacts would not be compared in a quantitative manner, the final decision would be a matter of judgment. With such an approach we lose the opportunity of quantifying those costs and benefits which can be quantified and of comparing them on an equal basis. We also relinquish the use of an important measure for ranking our projects, namely the economic rate of return. Our choice thus becomes more of a question of judgment rather than a decision based on a quantity.

However there are several advantages to this approach. First, for complex projects with many options and adverse impacts, it provides a valuable tool for summarizing the relevant information; for simpler schemes it serves as a useful checklist. Second, it provides a useful basis for a more objective debate, taking into account the whole range of impacts of each option put forward. Such an approach is necessarily more participatory as the views of all relevant groups would be accounted for in the identification of impacts. Third, it helps to identify how different groups are affected, revealing to the analyst and decision-makers the pattern of winners and losers created by the project. Fourth, it provides a basis for decision makers to reach rational judgements on schemes, taking into account the full range of benefits and costs. Finally, a more simplified format can be used at the preliminary appraisal stages to help in project screen and prioritize the project.

Examples of this approach are the frameworks (matrices, tableaux, planning balance sheets, etc.) used by the main European countries to appraise road and transport investments and predict results of projects. In the case of the UK Department of Transport, these frameworks were recommended by the ACTRA Report of 1977 as a method of ensuring that assessment was not dominated by factors which were susceptible to valuation in money terms. The ultimate design of a framework will be influenced by the nature of the project and the specific features of the process of appraisal. For instance, project appraisal involves a high degree of uncertainty in that all the implications of a particular choice cannot be known in advance. It also requires judging the relative importance of a large range of disparate impacts. Another feature is the large range of people who have an interest in the outcome. These groups will want to have information regarding all the relevant effects of the project and will also wish to know how they themselves will be affected. The appraisal method must therefore bring together large amounts of disparate information in a rational manner, must allow interested members of the general public to be informed of the issues and to form their own views, and must help in the decision-making which must be based on comprehensive but not necessarily quantified data.

Past experience with the use of frameworks in the UK indicates some of the characteristics which a framework must have. First, all effects which are relevant, or might reasonably be thought to be relevant, should be included. These would include all travel benefits, environmental effects on buildings and open spaces and on the people using them, planning and land use consequences, property and labor market effects, enterprise development and productive activity, and trade effects. Expertise would be required to avoid double counting of costs and benefits and to deal correctly with
transfers (taxes, subsidies, tolls, revenues). Second, it must be borne in mind that quantification of impacts is not an end in itself. Where quantification comes naturally this should be done, but otherwise a verbal description is sufficient. Third, judgement will be at the heart of the process, and the final decision of which option will be based on a comparison of the effects of each option. The ACTRA report suggested that options be compared two at a time until the best has been found.

Given the range of impacts that transport has on the economy and on different groups, many of which are not easily quantified but most of which are relevant to decisions, such frameworks should be adopted more widely in the appraisal of transport projects and policy reforms in developing countries. They should first however be used on an experimental basis in order to improve our understanding of the process and to assess their feasibility in the context of the poorer countries with weaker administrative and institutional capabilities. Additional research would be useful to find out where such methods have been used and with what success. Effective use of frameworks in the appraisal of projects and formulation of policies in developing countries will require that the following minimum criteria are satisfied:

(i) administrative, financial and human resources required should be inexpensive;

(ii) the process and techniques should be well understood by transport authorities and comprehensible to the general public; and

(iii) given the inherently judgmental nature of the decision-making process, the process should be open and beyond the control of any one particular group.

**Transport and structural adjustment**

The strong linkages between transport and the economy identified in this paper suggest that transport has an important role to play in the effectiveness of structural adjustment. The basic objective of structural adjustment is to eliminate balance of payments deficits through: (i) reducing absorption of goods by the economy so that the aggregate value of goods demanded for consumption and investment does not exceed the production and income of the economy; (ii) changing the relative price of tradeables and non-tradeables to provide incentives for increased production of tradeables and decreased production of non-tradeables; and (iii) shifting the production possibility frontier outward through improved resource allocation and efficiency in resource use or by increasing the amount of existing inputs. The importance of infrastructure in the adjustment process is recognized when we consider that infrastructure is an intermediate good in the production of tradeables and non-tradeables as well as a final good that is typically non-tradeable. As an input into the production process it also influences the location of the production possibility frontier.

Demand management policies which reduce the consumption of final goods, including final transport services, will not badly affect the adjustment process. (If poverty alleviation is an objective however, the impact of reduced consumption of transport services, particularly for the poor, could be severe. We should also remember that transport is essential for getting people to work and for the success of micro-enterprises which are often family based.) However, if demand management policies constrain the demand by firms of intermediate inputs, including transport, this will restrict the production of tradeables and non-tradeables. Expenditure-switching policies which improve the price of tradeables relative to non tradeables will not be as effective if the desired supply response is restricted by reductions in infrastructure. We have seen that efficient transport is critical to the production and marketing of tradeable goods. Some investments, such as ports, are dedicated to use in the production of tradeables while others, such as freight transport, are used mainly as intermediate inputs in the production of tradeables.
Adjustment programs often seek to delay infrastructure investment and maintenance during adjustment with the expectation that adjustment will occur rapidly. This may be of little consequence in the short term; however, recent reviews of the experience with structural adjustment indicate that it typically takes longer than many analysts originally thought. Consequently, postponement of infrastructure investment and maintenance is beginning to reduce the infrastructure capital stock in many countries, with disastrous consequences for future growth prospects.

The evidence so far establishes that structural adjustment affects the provision of transport infrastructure and services, and that the condition of a country's transport affects the success of structural adjustment. Nevertheless, Ingram cites evidence that infrastructure has been severely treated by countries undergoing adjustment. A recent review of public sector investment and expenditure reviews carried out by the Bank indicated that such reviews recommended reductions in urban infrastructure investments of 26 percent and reductions in water and sewerage investments of 16 percent. A review of the adjustments to public expenditures in highly indebted countries reports that expenditure reductions are concentrated in capital intensive sectors, and particularly infrastructure. Between 1978 and 1984, in a group of 11 highly indebted countries, it was found that, while overall government expenditures rose 16 percent, infrastructure expenditures fell 8 percent - the only sector to decline.

Evidence about the linkages between transport infrastructure and economic growth may be grounds for reassessing some of the choices being made in adjustment programs. Different infrastructure and services will have different impacts on production and trade. The stimulation of export industries in structural adjustment will require a close examination of port facilities and transport infrastructure related to the movement of freight. Infrastructure services that are strongly oriented to household final consumption may be generally less important to structural adjustment. However, if there are concerns about poverty alleviation through improving access to employment and public facilities, reducing time spent travelling, and stimulating the development of micro enterprises, then such final transport services will be critical.
NOTES


2. It is necessary to distinguish between transport infrastructure (rural and urban roads and highways) and the transport modes (motorized and non-motorized) which use the infrastructure to yield services. There is also a policy and institutional framework which affects the operation of the industry and the flow of services.

3. For a literature review, see Fox, William F. (1990), The Contribution of Infrastructure Investments to Growth: A Review of the Literature, University of Tennessee, Unpublished.


40. Ibid.

41. Ibid.

42. See Deaton, Angus (1987), The Demand for Personal Travel in Developing Countries, The World Bank, Infrastructure and Urban Development Department, Report INU 1.

43. For a review of theories of urban residential location, see Mills, Edwin S. ed. (1987), Handbook of Regional and Urban Economics, Vol. 2, Ch. 18.


47. Ahmed, Raisuddin and Mahabub Hossain (1990), Development Impact of Rural Infrastructure in Bangladesh, International Food Policy Research Institute, Research Report 83.


55. Mohring, Herbert, "Land Values and the Measurement of Highway Benefits".


57. Kranton, Ibid.


59. Kranton, Ibid.


61. For instance, port charges in Brazil are US$40 per ton, while in EEC countries they are US$10 per ton. See Brazil: Medium Term Strategy Paper for the Infrastructure Sectors, Rpt. No. 9473-BR, 1991, Vol. 1, p. 14. of Attachment E.

62. Order cycle times in the OECD countries have fallen dramatically and more than 60% of production and sales in these markets are now processed directly to order. See Peters, Hans J., Trade and Industry Logistics in Developing Countries: A Strategy for Improving Competitiveness in Changing International Markets, Transport Division, Infrastructure and Urban Development Department, The World Bank, p. 7, unpublished.

63. When asked which infrastructure element has the most decisive influence on their logistics performance, trade and industry managers referred without exception to electronic communication systems with transport ranking a close second. Ibid., p. 15.

64. Ibid, p. 21.

65. Ibid, p. 23

66. Freight indexes in 1986 (1978 = 100) for 20 commodities imported by the United States were 88 for Chile, and 123 (on average) for countries along the East coast of South America. Ibid. p. 26.


71. These are Ethiopia, Ghana, Zaire, Indonesia, Philippines, Sri Lanka, Thailand, Argentina, Colombia, Costa Rica, Jamaica, Algeria, Pakistan and Tunisia.

72. There were several difficulties involved, including problems in assembling figures for similar years, widespread gaps in the information obtained on subsidies, the breakdown of interest payments, and lack of information on sources/recipients of current year additions to, or repayments of, loan capital.


74. The Report of the Advisory Committee on Trunk Road Assessment, October 1977, Department of Transport, UK.


<table>
<thead>
<tr>
<th>Country</th>
<th>Address</th>
<th>City/Country</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARGENTINA</td>
<td>Carlos Hinch, SRL, Galería Guemes Florida 158, 4th Floor-Ofc. 451/466</td>
<td>1333 Buenos Aires</td>
</tr>
<tr>
<td>AUSTRALIA, PAPUA NEW GUINEA, FIJI, SOLOMON ISLANDS, VANUATU, AND WESTERN SAMOA</td>
<td>D.A. Information Services 644 Whitehorse Road Mitcham 3132</td>
<td>Victoria</td>
</tr>
<tr>
<td>BANGLADESH</td>
<td>Micro Industries Development Assistance Society (MIDAS) House S, Road 16 Dhaka 1209</td>
<td>Dhaka 1209</td>
</tr>
<tr>
<td>BELGIUM</td>
<td>Jean De Lanoy Av. du Roi 202 1060 Brussels</td>
<td>Brussels 1060</td>
</tr>
<tr>
<td>CANADA</td>
<td>Le Diffuseur C.P. 49, 15018 rue Aumporte Boucherville, Québec 148 5J6</td>
<td>Boucherville</td>
</tr>
<tr>
<td>CHILE</td>
<td>Inverte ICT S.A. Av. Santa Maria 6600 Edificio INTEC, CT. 201 Santiago</td>
<td>Santiago</td>
</tr>
<tr>
<td>CHINA</td>
<td>China Educational &amp; Economic Publishing House 8, Da Fo Si Dong Jie Beijing</td>
<td>Beijing</td>
</tr>
<tr>
<td>COLOMBIA</td>
<td>Informatica Ltd. Apartado Aereo 34270 Bogota D.E.</td>
<td>Bogota</td>
</tr>
<tr>
<td>COTE D'IVOIRE</td>
<td>Centre d’Edition et de Diffusion Africaines (CEDA) 04 B.P. 541 Abdajan 04 Plateau</td>
<td>Abidjan</td>
</tr>
<tr>
<td>CYPRUS</td>
<td>Center of Applied Research Cyprus College 6, Diogene Street, Engomi P.O. Box 2006</td>
<td>Nicosia</td>
</tr>
<tr>
<td>DENMARK</td>
<td>SamfundsLitteratur Rosenmore Ast 11 DK-1970 Frederikshong C</td>
<td>Copenhagen</td>
</tr>
<tr>
<td>DOMINICAN REPUBLIC</td>
<td>Editoriales del Cobre, Cpor A. Restauracion e isabel la Catolica 309 Apartado de Correos 2190 Z-1</td>
<td>Santo Domingo</td>
</tr>
<tr>
<td>EGYPT, ARAB REPUBLIC OF</td>
<td>Al Ahran, Al Qalais Street, Cairo</td>
<td>Cairo</td>
</tr>
<tr>
<td>FINLAND</td>
<td>Akademien Kirjakauppa P.O. Box 128 SF-00101 Helsinki 10</td>
<td>Helsinki</td>
</tr>
<tr>
<td>FRANCE</td>
<td>World Bank Publications 66, avenue d’lona 75116 Paris</td>
<td>Paris</td>
</tr>
<tr>
<td>GERMANY</td>
<td>UNO-Verlag Pappelnderfer Alle 55 D-5300 Bonn 1</td>
<td>Bonn</td>
</tr>
<tr>
<td>HONG KONG, MACAO</td>
<td>Asia 2000 Ltd. 46-48 Wyndham Street Winning Centre 2nd Floor Central Hong Kong</td>
<td>Macao</td>
</tr>
<tr>
<td>INDIA</td>
<td>Allied Publishers Private Ltd. 781 Mount Road Madras - 600 002</td>
<td>Madras</td>
</tr>
<tr>
<td>INDONESIA</td>
<td>Pl. Indira Limited Jalan Besar 70 P.O. Box 181 Jakarta 1032</td>
<td>Jakarta</td>
</tr>
<tr>
<td>IRELAND</td>
<td>Government Supplies Agency 4-5 Harcourt Road Dublin 2</td>
<td>Dublin</td>
</tr>
<tr>
<td>ISRAEL</td>
<td>Yemstut Literature Ltd. P.O. Box 56055 Tel Aviv 61550</td>
<td>Tel Aviv</td>
</tr>
<tr>
<td>ITALY</td>
<td>Liceo Commissionaria Sansepol SPA, Via Duca Di Calabria, 1/1 Casella Postale 352 50125 Firenze</td>
<td>Firenze</td>
</tr>
<tr>
<td>JAPAN</td>
<td>Eastern Book Service Hong Kong 3-Chome, Bunkyo-ku 11 Tokyo</td>
<td>Tokyo</td>
</tr>
<tr>
<td>KENYA</td>
<td>Africa Book Service (E.A.) Ltd., Quran House, Jinnangi Street P.O. Box 42545</td>
<td>Nairobi</td>
</tr>
<tr>
<td>KOREA, REPUBLIC OF</td>
<td>Pan Korea Book Corporation P.O. Box 101, Kwangwhamun Seoul</td>
<td>Seoul</td>
</tr>
<tr>
<td>MALAYSIA</td>
<td>University of Malaya Cooperative Bookshop, Limited P.O. Box 1127, Jalan Pantai Baru 59700 Kuala Lumpur</td>
<td></td>
</tr>
<tr>
<td>MEXICO</td>
<td>INFOTEC Apartado Postal 22-860 16400 Tlalpan, Mexico D.F.</td>
<td>Mexico</td>
</tr>
<tr>
<td>NETHERLANDS</td>
<td>De Lindeboom/InOr-Publicaties P.O. Box 202 7400 AHeekbergen</td>
<td>Amsterdam</td>
</tr>
<tr>
<td>NEPAL</td>
<td>Nepal Book Agency, Private Mail Bag 9914 New Market Auckland</td>
<td>Auckland</td>
</tr>
<tr>
<td>NIGERIA</td>
<td>University Press Limited Three Cornes Building Jericho Private Mail Bag 5095</td>
<td>Italian</td>
</tr>
<tr>
<td>NORWAY</td>
<td>Narvesen Information Center Book Department P.O. Box 6125 Elterodet N-0602 Oslo 6</td>
<td>Oslo</td>
</tr>
<tr>
<td>PAKISTAN</td>
<td>Mirza Book Agency 65, Shahbaz-e-Quaid-e-Azam P.O. Box No. 72 Lahore 5400</td>
<td>Lahore</td>
</tr>
<tr>
<td>PHILIPPINES</td>
<td>International Book Center Suite 1701, Candler, Mexico recognised by the G-20</td>
<td>Mexico</td>
</tr>
<tr>
<td>POLAND</td>
<td>Polish Information Service for Abonnements Case postal 3312 CH 1052 Warszawa</td>
<td>Warszawa</td>
</tr>
<tr>
<td>PORTUGAL</td>
<td>Editorial do Brasil 60 A Central Bazaar 500 Bajaj Nagar Condominium Tower 1</td>
<td>Mumbai</td>
</tr>
<tr>
<td>PHILIPPINES</td>
<td>International Book Center Suite 1701, Candler, Mexico recognised by the G-20</td>
<td>Mexico</td>
</tr>
<tr>
<td>POLAND</td>
<td>Polish Information Service for Abonnements Case postal 3312 CH 1052 Warszawa</td>
<td>Warszawa</td>
</tr>
<tr>
<td>SOUTH AFRICA, BOTSWANA</td>
<td>Africa Book Service (E.A.) Ltd., Quran House, Jinnangi Street P.O. Box 42545</td>
<td>Johannesburg</td>
</tr>
<tr>
<td>SWITZERLAND</td>
<td>For single title: Librairie Payot Case postal 3122 CH 1052 Lausanne</td>
<td>Lausanne</td>
</tr>
<tr>
<td>TRINIDAD &amp; TOBAGO, ANTIGUA</td>
<td>For single title: Librairie Payot Service des Abonnements Case postal 3312 CH 1052 Lausanne</td>
<td>Lausanne</td>
</tr>
<tr>
<td>UNITED KINGDOM</td>
<td>For single title: Librairie Payot Service des Abonnements Case postal 3312 CH 1052 Lausanne</td>
<td>Lausanne</td>
</tr>
<tr>
<td>VENEZUELA</td>
<td>For single title: Librairie Payot Service des Abonnements Case postal 3312 CH 1052 Lausanne</td>
<td>Lausanne</td>
</tr>
<tr>
<td>No.</td>
<td>Title</td>
<td>Authors/Editors</td>
</tr>
<tr>
<td>-------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>198</td>
<td>Water Allocation, Rights, and Pricing: Examples from Japan and the United States</td>
<td>Teerink and Nakashima</td>
</tr>
<tr>
<td>199</td>
<td>The Development of Cooperatives and Other Rural Organizations: The Role of the World Bank</td>
<td>Hussi, Murphy, Lindberg, and Brenneman</td>
</tr>
<tr>
<td>200</td>
<td>Settlement and Development in the River Blindness Control Zone: Case Study Burkina Faso</td>
<td>McMillan, Nana, and Savadogo</td>
</tr>
<tr>
<td>201</td>
<td>Improving Water Use in Agriculture: Experiences in the Middle East and North Africa</td>
<td>Van Tuijl</td>
</tr>
<tr>
<td>203</td>
<td>A Strategy to Develop Agriculture in Sub-Saharan Africa and a Focus for the World Bank</td>
<td>Cleaver</td>
</tr>
<tr>
<td>204</td>
<td>Agricultural Technologies for Market-Led Development Opportunities in the 1990s</td>
<td>Barghouti, Cromwell, and Pritchard editors</td>
</tr>
<tr>
<td>205</td>
<td>Using Water Efficiently: Technological Options</td>
<td>Xie, Küffner, and Le Moigne</td>
</tr>
<tr>
<td>207</td>
<td>Participatory Evaluation: Tools for Managing Change in Water and Sanitation</td>
<td>Narayan</td>
</tr>
<tr>
<td>208</td>
<td>Evaluation of the Performance of T&amp;V Extension in Kenya</td>
<td>Bindlish and Evenson</td>
</tr>
<tr>
<td>209</td>
<td>Property Tax: A Practical Manual for Angophone Africa</td>
<td>Keith</td>
</tr>
<tr>
<td>210</td>
<td>Living with Trees: Policies for Forestry Management in Zimbabwe</td>
<td>Bradley and McNamara editors</td>
</tr>
<tr>
<td>211</td>
<td>Integrated Pest Management and Pesticide Regulation in Developing Asia</td>
<td>Wiebers</td>
</tr>
<tr>
<td>212</td>
<td>Water Resources Management in Asia, Volume 1: Main Report</td>
<td>Frederiksen, Berkoff, and Barber</td>
</tr>
<tr>
<td>213</td>
<td>Best Practices for Moving Seed Technology: New Approaches to Doing Business</td>
<td>Srivastava and Jaffee</td>
</tr>
<tr>
<td>214</td>
<td>Agro-pastoralism in Chad as a Strategy for Survival: An Essay on the Relationship between Anthropology and Statistics</td>
<td>Bonfiglioli</td>
</tr>
<tr>
<td>215</td>
<td>Irrigation-Induced Salinity: A Growing Problem for Development and the Environment</td>
<td>Umali</td>
</tr>
<tr>
<td>216</td>
<td>Improving Cash Crops in Africa: Factors Influencing the Productivity of Cotton, Coffee, and Tea Grown by Smallholders</td>
<td>Carr</td>
</tr>
<tr>
<td>217</td>
<td>Getting Ready for the Twenty-First Century: Technical Change and Institutional Modernization in Agriculture</td>
<td>Antholt</td>
</tr>
<tr>
<td>218</td>
<td>Bibliography of Publications: Technical Department, Africa Region, July 1987 to December 1992</td>
<td>Mohan</td>
</tr>
<tr>
<td>219</td>
<td>Alcohol-Related Problems as an Obstacle to the Development of Human Capital: Issues and Policy Options</td>
<td>Cercone</td>
</tr>
<tr>
<td>220</td>
<td>Managing Urban Environmental Quality in Asia</td>
<td>Kingsley</td>
</tr>
<tr>
<td>221</td>
<td>Conserving Soil Moisture and Fertility in the Warm Seasonally Dry Tropics</td>
<td>Srivastava, Tamboli, English, Lal, and Stewart</td>
</tr>
<tr>
<td>222</td>
<td>Innovations in Higher Education: Singapore at the Competitive Edge</td>
<td>Selvaratnam</td>
</tr>
<tr>
<td>223</td>
<td>Strategies for Family Planning Promotion</td>
<td>Piotrow, Treiman, Rimon, Yun, and Lozare</td>
</tr>
<tr>
<td>224</td>
<td>Urban Transport in Asia: An Operational Agenda for the 1990s</td>
<td>Midgley</td>
</tr>
<tr>
<td>225</td>
<td>A Governance Approach to Civil Service Reform in Sub-Saharan Africa</td>
<td>Dia</td>
</tr>
<tr>
<td>226</td>
<td>Evaluation of T&amp;V-Based Extension in Burkina Faso</td>
<td>Bindlish, Evenson, and Gbetibouo</td>
</tr>
<tr>
<td>228</td>
<td>The Emergence of Private Sector Manufacturing in St. Petersburg: A Survey of Firms</td>
<td>Webster and Charap</td>
</tr>
<tr>
<td>229</td>
<td>The Emergence of Private Sector Manufacturing in Hungary: A Survey of Firms</td>
<td>Webster</td>
</tr>
<tr>
<td>230</td>
<td>The Emergence of Private Sector Manufacturing in the Former Czech and Slovak Federal Republic: A Survey of Firms</td>
<td>Webster and Swanson</td>
</tr>
<tr>
<td>231</td>
<td>Cotton Production Prospects for the Decade to 2002: A Global Review</td>
<td>Eisa, Barghouti, Gillham, and Al-Saffy</td>
</tr>
</tbody>
</table>