

PHYSICAL INFRASTRUCTURE AND INTERNATIONAL COMPETITIVENESS AT THE FIRM LEVEL: IMPLICATIONS FOR DEVELOPING ECONOMIES

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Among other factors, international competitiveness at the firm level depends on the provision of well-maintained and efficient physical infrastructure networks. Infrastructure networks, such as telecommunications, electricity, gas, irrigation, and transport services, play a strong complementary role in firms' ability to create and maintain their competitiveness through creating more value than their competitors. In developing countries, the issues relating to inefficiencies in the provision of infrastructure services are closely linked with firms' ability to acquire international competitiveness. In many instances, efficiency, as well as adequacy norms of infrastructure networks, can be achieved by changing the institutional settings and creating a competitive environment in the provision of infrastructure services.

1. Introduction

This paper focuses on the role that physical infrastructure plays in creating international competitiveness at the firm level. The positive impact of physical infrastructure on the rate of return on private capital, for example, creates favorable conditions that help firms achieve higher level of productivity and profits (World Bank, 1994). There is an emerging consensus that, among other factors, it is the poor performance of the physical infrastructure that explains the inefficiencies at the enterprise level. Such inefficiencies are more pronounced in developing countries where it is "very hard to run factories and businesses effectively when the electricity and water supplies are unreliable, the telephone and the mail services are weak, and transport is slow, costly and hazardous" (Stern, 1991, p. 128).

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Firms' value adding activities are influenced by physical infrastructure services that are used in their production processes. This complementary nature of the physical infrastructure in the production process, therefore, influences the productivity, cost, and profitability at the enterprise level. Among other factors, the provision of physical infrastructure helps firms reduce their response time, improve the efficiency of purchasing, production and marketing functions, expand their ability for global sourcing to lower their production costs, and reduce their logistic costs. At a time when the growing globalization has shortened the product life cycle, efficient logistic processes play a key role in firms' bid to acquire international competitiveness. Firms use the logistic processes to plan, implement, and control the efficient and effective flow and storage of intermediate goods, finished products, services, and related information from their origin to the location where they are used or consumed. Therefore, a smooth functioning of the logistic processes helps firms deliver desired goods at the right time and at the right price regardless of where the product is being produced (Fawcett and Clinton, 1997). It is evident that the efficient provision of physical infrastructure networks is a prerequisite to place cost-saving and revenue-enhancing logistic processes.

Firms' cost structures are also sensitive to the quality and reliability of infrastructure services. For instance, a reliable electricity supply helps a firm maintain an uninterrupted production run, meet export deadlines, and keep its adherence to cost minimizing "just in time" production philosophy. The provision of physical infrastructure, such as land, sea and air transportation, telecommunications infrastructure, power supply, and highways, has played a major role in creating and sustaining the competitiveness of key industries in newly industrialized Asian economies (Chia, 1994; Lau, 1994).

The paper is organized as follows. Section 2 examines the relationship between international competitiveness and physical infrastructure and analyzes the impact of such a link on firms engaged in global competition. This section develops a conceptual framework that illustrates the role of physical infrastructure in shaping international competitiveness at a firm level. Section 3 highlights the adequacy and efficiency issues in the provision of physical infrastructure and their consequences on firms' ability to create and maintain international competitiveness in developing countries. Section 4 evaluates the po-

tential for infrastructure reforms to stimulate competition in the provision of infrastructure services and thus enhance the international competitiveness at enterprise level. Section 5 provides conclusions drawn from the study.

2. The Infrastructure-Productivity-Competitiveness Framework

International competitiveness has become a major issue in the public policy arena both in developed as well as in developing countries. There is growing interest in exploring how firms or industries can achieve and maintain their competitiveness at the global level. There have been attempts to explore the factors that determine competitiveness at the firm or industry level. This leads us to a fundamental question regarding the meaning of competitiveness at the firm level and the way it relates to competitiveness at the national level. Attempts have been made to explain a nation's competitiveness in terms of its trade related indicators, such as real exchange rates (Dwyer, 1991), trade performance (Wells and Imber, 1977; Cas, et al., 1988; Daniels, 1992), and the terms of trade (Arndt, 1993). However, evidence from industrialized and Asian economies indicates that these countries have achieved higher standards of living while running persistent trade deficits. There is also an argument that a nation's competitiveness can be gauged from its relative unit labor cost (Enoch, 1978; Rao and Lempriere, 1992a). However, it is the higher-wage countries, such as Japan and Germany, that have outperformed the less developed low-wage nations (Carbaugh, 1998). Porter (1990), Markusen (1992), Dollar and Wolf (1993), and Parry (1994) assert that a nation's competitiveness, among other factors, relates essentially to the productivity performance of its employed resources. It is the productivity performance of its resources that results in an increasingly high standard of living of a nation.

Stern (1991) points to six key determinants of productivity performance at the national level: (1) capital accumulation; (2) human capital; (3) research, development, and innovation; (4) management and economic organization; (5) physical infrastructure; and (6) resource allocation among different sectors of an economy. These determinants, along with factors such as market structure and openness to world trade, determine the national environments that influence the

competitiveness at the firm level. Following this line of reasoning, therefore, a firm's relative productivity performance indicates its relative superiority of resource use and thus its international competitiveness. The productivity link, according to this framework, provides a conceptual framework to study the interaction between a firm's international competitiveness and its national environment in which the provision of physical infrastructure plays an important part.

The rate of productivity growth has a direct bearing on a firm's ability to acquire international competitiveness. Factors such as a worker's motivation and skill level, nature of the product and technology in use, scale of production, and the internal organization of the firm, play an important role in productivity growth. This, however, is a rather narrow view of the concept of international competitiveness, as it only looks at the cost-based perspective of productivity, ignoring the firm's ownership of other unique assets, e.g., quality, reliability, and service, that influence the value adding process at the firm level.

It is important to recognize that firms strive to enhance their competitiveness through creating more value than their competitors. It is the growth in the cumulative value added by a nation's enterprises that result in higher living standards and well being. Whereas a productivity-led advantage is important and leads to lower per unit costs, a quality and service driven competitive advantage helps accelerate the value creation process through higher product prices, increased market share, and higher prices with a greater market share. An efficient provision of physical infrastructure contributes in value creation by helping firms acquire both productivity-based, as well as quality- and services-based, advantages. Consequently, the ability to acquire and sustain relative superiority or competitiveness, among other factors, depends on the extent to which the prevailing physical infrastructure networks enable firms to accelerate their productivity growth and to optimize their resource exploitation efforts.

A conceptual framework that encompasses the above relationships and connects them with competitiveness at the firm level is outlined in the following model. The model contends that international competitiveness is determined by a firm's capacity to create value and is measured by value added per unit of labor (Ω); an index of international competitiveness. It is important to note that this index of international competitiveness is based on distortion-free world prices.

Where

$$\Omega = V/L$$

$$(1) \quad V = P \cdot Q - (M_C \cdot Q + I_C \cdot Q)$$

V = Value added

P = Per unit price of output

M_C = Average cost of intermediate materials

I_C = Average cost of infrastructure services

Q = Output

L = Labor

Value added per unit of labor, an index of international competitiveness, is derived by dividing (1) by L .

$$(2) \quad \Omega = V/L = (P \cdot Q)/L - \{(M_C \cdot Q)/L + (I_C \cdot Q)/L\}$$

But $Q/L = \lambda_L =$ Average labor productivity

$$\Omega = \lambda L \{P - (M_C + I_C)\}$$

Denoting $M_C + I_C = C^*$, we arrive at (3).

$$(3) \quad \Omega = \lambda L (P - C^*)$$

The above model points to a direct relationship between value added per worker or the international competitiveness of a firm to its productivity performance, and the level of price-cost (i.e., material and infrastructure cost) margins. Physical infrastructure inputs impact upon international competitiveness through their complementary role in raising productivity growth and by helping firms acquire firm-specific advantages that in turn influence the price-cost margins. The above model not only outlines the determinants of international competitiveness but it also provides a framework to analyze the role of infrastructure networks in influencing the intra-firm and inter-industry differences in international competitiveness.

3. Competitiveness and Physical Infrastructure: Issues in Developing Countries

The above model demonstrates that, under given conditions, an efficient provision of infrastructure services enables firms to improve their international competitiveness. The inability of a large number of developing countries to expand and/or to maintain the existing infrastructure networks, however, can cause infrastructure bottlenecks and congestion, severely affecting the value adding capabilities of their firms. Poor infrastructure provision adds an extra cost for firms, limiting their ability to compete in world markets and to contribute to national competitiveness. An inadequate provision of infrastructure networks also deters the inflow of foreign direct investment needed to complement domestic investment. For example, with rapid economic growth and rising exports in Thailand, congestion of roads, telecommunications, and ports, in the absence of adequate spending on further infrastructure, led to a drop in foreign direct investment (Warr, 1994).

In part, the inability of developing countries to achieve best practices in the provision of physical infrastructure has resulted from lack of funds. Increased spending on infrastructure networks, however, is not always the answer to improve operational efficiency. In many cases, poor performance of infrastructure services can be traced back to their poor governance; misallocation and waste of resources; weak institutional arrangements; lack of accountability, autonomy, and incentives; poor maintenance; absence of competition; and financial difficulties (World Bank, 1994).

For instance, while the provision of electricity requires a high set up cost, a failure to run an existing power facility efficiently can have far reaching implications for firms' efforts to achieve higher levels of productivity growth. A study of power utilities in 51 developing countries indicates that technical efficiency has in fact declined over the past 20 years, severely undermining developing countries' efforts to achieve a new equilibrium at a higher growth path (Ingram and Kessides, 1994). In developing countries, power blackouts and brownouts have adversely effected firms' ability to capitalize their value adding potential. A study of the Pakistani small- and medium-sized firms confirms the negative consequences of power blackouts on output, value added, and industrial costs (Ahmad, 1995). Similarly, in

India, the output loss due to power cuts and power shortages is estimated to be between 1 to 3.5 percent of annual GDP.¹ Not surprisingly, therefore, 40 percent of the power-generating capacity in developing countries is unavailable for production. Inefficiencies in power utilities have led private sector firms in many developing countries to invest in their own power generators in order to have a reliable source of power supply. Although reliable, these generators operate at 50 percent capacity and are not cost effective, thus adding an extra burden to the firms' cost structure (World Bank, 1994).

Similar examples of technical inefficiencies and production losses are evident in the case of the transportation and communication sectors. Effective transportation and communication systems reduce firms' costs of production and distribution, and enable them to expand domestically, as well as globally. Firms' ability to contribute to the growth process and to participate in world trade may be seriously compromised if they are subject to inefficient transport and communication networks. There is an emerging consensus among national policymakers in developing countries that to compete in an increasingly integrated world market, these countries must improve the efficiency and quality of their transport and communication infrastructure services.² Efficient road, sea, airport, and railroad networks, while improving the international competitiveness of productive activities, also make these economically more viable. However, by contrast, port facilities in developing countries download cargo from each ship at only 40 percent the speed of those ports that follow best practices. In African and Latin American railways, almost 50 percent of the labor force is believed to be redundant. Inadequate maintenance of roads in developing countries has led to a situation where the rate of deterioration is 50 percent faster than if the roads were well maintained (Ingram and Kessides, 1994).

In developing countries the extension of transport and communication infrastructure and services can play a key role in firms' efforts to participate in global trade and in attracting much needed

¹ For a detailed study, see Arun (1991).

² United Nations, 1997. *Economic and Social Survey of Asia and the Pacific*. New York: Economic and Social Commission for Asia and the Pacific.

foreign direct investment. It is important to note, however, that an improvement in the efficiency of transport infrastructure and services is as important as their expansion. The problem for developing countries is therefore not confined to an inadequate coverage of infrastructure networks, but extends to the failure to achieve operational efficiencies for a given level of coverage. This is especially true for those countries where solving congestion and bottlenecks within the existing infrastructure facilities, such as road, rail, air, and port networks, would be far more rewarding than their further expansion. While removing infrastructure congestion and bottlenecks extends the life of these networks, this also results in productivity enhancement, time contraction, and reduced transportation costs for firms.

Finally, while an improvement in the efficiency of operating the existing infrastructure networks is important, a failure to further invest in these networks in a growing economy can halt firms' efforts to achieve or sustain international competitiveness. The above proposition is especially true for the high-growth East Asian economies, which have witnessed an unprecedented economic growth over the past two decades. Even with an economic slowdown, the infrastructure needs of these economies will continue to grow due to urbanization and globalization of trade in goods and services. According to one estimate, the investment requirements for infrastructure in East Asia alone are projected to amount to \$1.5 trillion for the period of 1995-2004 (World Bank, 1996). These figures suggest that, among other factors, the provision of adequate infrastructure services is essential for the East Asian firms to sustain and enhance their international competitiveness.

4. International Competitiveness and Infrastructure Reforms: An Agenda for Change

Although various physical infrastructure networks differ in terms of their technologies, capital requirements, skill needs, and demand conditions, their lackluster performance in developing countries stems from a set of common generic factors. These factors include insufficient maintenance, technical inefficiency, under or excess capacity, lack of customer focus, lack of competition, lack of managerial and financial autonomy, flawed pricing policies, absence of a system of incentives and accountability, and a lack of motivation to upgrade the

system and its delivery. In many instances, these generic factors are the outcome of institutional arrangements that require public provision of physical infrastructure.

A major rationale for the public provision of physical infrastructure networks has always been the high set up costs required to result in economies of scale in production. Under such conditions, economic efficiency is achieved if a single provider meets the given demand. The provision of infrastructure by an unregulated single provider, however, leads to monopoly profits and inefficiencies. Hence, there lies a justification for public provision of physical infrastructure systems. In recent times, however, there has been a growing realization among policymakers and practitioners that there are some aspects of physical infrastructure services that exhibit private goods characteristics and that could be opened for effective competition to achieve static, as well as dynamic, efficiency gains. For instance, there is little dispute that the electricity industry exhibits both contestable, as well as natural, monopoly elements. To increase the productivity and the efficiency of this industry, therefore, economic reforms are essential to promote competition in the generation and retail sector while regulating its transmission and distribution functions. Like the power industry, gas utilities exhibit elements of both natural monopoly and contestability. While competition in transmission and distribution is wasteful, production and marketing operations are contestable. In other words, providing third party access to pipeline services can lead to rising productivity and higher value added for the providers, as well as the end users.

Further, multiple providers in the telecommunication sector can provide long-distance services that impact on consumer welfare, speed of innovation, and technical efficiency. In many developing countries, it is the only sector with an average ratio of revenue to cost over 1.5, that contributes to state revenue through its profits (Swaroop, 1994). The financial profitability of a public enterprise, however, does not shed any light on the quality of its service or its efficiency; achieving the latter requires the presence of a competitive environment. In the case of telecommunications, high incidence of call failure, system breakdowns, and low productivity, can have ripple effects on a firm's ability to create value.

In the case of the transportation sector, rail tracks, railway stations, city roads, port and airport facilities exhibit very low potential for competition. However, encouraging competition in areas such as rail freight and passengers services, cargo handling, shipping and airlines, can still enhance the efficiency and effectiveness of this sector. For instance, in the case of railways, there is no doubt that the cost of building and maintaining the infrastructure necessary to provide rail services is a major barrier to entry. However, third-party access to rail infrastructure increases the scope for competition in passenger and freight services. For port facilities, the potential for inter-port, competition-driven productivity growth depends on factors such as the distance between ports, the concentration of population and industry in coastal centers, and the relative cost of land transportation. The importance of these factors however differs from one country to another. For example, in a country where distances between ports are large and land transport costs are also high, it will be difficult to envisage the emergence of competition-driven productivity growth. Under these circumstances, administrative, pricing, and institutional reforms can bring about the desired productivity gains (Industry Commission, 1997).

A major direct benefit of implementing infrastructure reforms such as privatization, deregulation, corporatization, and administrative and pricing reforms, is their potential for cost recovery and efficiency gains that, apart from helping improve macroeconomic stability, provides resources for further infrastructure investment and upgrading. According to Ingram and Fay (1994), developing countries can save \$55 billion a year as pure resource savings through proper road maintenance; reducing the transmission, distribution, and generation of losses in the power sector; minimizing water leakages; and economizing on fuel use and staffing.³

As we have noted earlier, implementing infrastructure reforms alone will not be enough for firms in developing countries to attain or sustain international competitiveness. With rapid urbanization and globalization of trade, further investment in upgrading and expanding the infrastructure networks will be required to help firms accelerate their rate of productivity growth and value creation. Resource

³ For a detailed discussion on this, see World Bank (1994).

mobilization to finance infrastructure investment in developing countries is a difficult task. In the absence of adequate domestic capital, investment in infrastructure can be financed from external sources by borrowing from international capital markets and/or encouraging foreign direct investment. In situations where the domestic private sector is willing to participate in infrastructure projects but is constrained due to institutional rigidities, a move towards competitive bidding to construct and operate infrastructure networks can complement or substitute foreign capital involvement in the provision of infrastructure services.

5. Conclusions

This paper contends that a firm's relative productivity performance and price-cost margin determine its relative superiority to create value or international competitiveness. It is the ability to create value at the firm level that, under a given set of national environments, results in a nation achieving higher standards of living and competitiveness. Among the factors that determine national environments, provision of physical infrastructure inputs plays a key complementary role in determining the international competitiveness at firm level.

Apart from an inadequate provision of physical infrastructure services, a key constraint faced by firms in developing countries is the prevalent inefficiencies in delivering these services. These inefficiencies lead to higher logistic costs, longer response time, interrupted production runs, lower productivity, higher industrial costs, poor price-cost margins, and lower value added. For developing countries, efforts to improve competitiveness at a firm level would require removing infrastructure inefficiencies and bottlenecks that in most cases are caused by weak and ineffective institutional settings.

This paper emphasizes the need for a policy shift from the provision of infrastructure services through state-run, regulated infrastructure networks towards a regime that provides such services under competitive environments. The emergence of competitive conditions in developing countries, however, would require a major effort and commitment to introduce the necessary infrastructure reforms. These reforms have an enormous potential to assist firms to acquire and enhance their international competitiveness.

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