Research Policy Brief 27

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1. Introduction

Infrastructure services play a significant role in trade costs by reducing distribution margins, lowering prices, and raising consumer welfare.[1] They also lower transaction costs, add value, and increase profitability for exporters while expanding linkages to global distribution networks. Infrastructure is a significant determinant of both export levels and the likelihood of exporting at all (Francois and Manchin, 2007).

Nordas and Piermartini (2004) highlight four interactions between trade costs and infrastructure: (i) *Direct monetary outlays* are partly determined by charges for infrastructure services; (ii) *Timeliness* is influenced by infrastructure and geography; (iii) *Risk* of damage, losses and higher insurance costs rises when infrastructure is poor; and (iv) *Market access* may be limited by transport or telecommunications.

Infrastructure development can increase exports at the intensive margin (deepening existing shipment levels) and the extensive margin (new products or destinations). Expansion through new, small shipments from small firms at the extensive margin requires different transportation infrastructure than deepening existing trade flows.

Four recent changes in trade affect demand for transportation services: (i) changes in the weight to value ratio of traded goods;

[1] For more detailed discussion, see Brooks and Hummels, forthcoming.

(ii) demand for timeliness; (iii) newly traded products and trade routes, generally involving smaller shipments; and (iv) production fragmentation in geographic terms. Hummels (forthcoming) finds that the relationships are interlinked as, for example, declining weight/value ratios and vertical specialization in new, fragmented production networks yield new air cargo flows. Meanwhile, interactions between changing composition and volume of trade influence the bankability of infrastructure investments.

When differentiated among commodity groups, the weight to value ratio is a major determinant of transport cost, suggesting that road, rail, and sea transport modes may be in increasing order of preference for heavier cargos. Hummels and Skiba (2004) found that a 10 percent increase in the product weight to value ratio results in a four percent increase in shipping costs.

The composition of freight charges varies significantly across countries and commodity categories. The share of total freight charges accounted for by inland freight is generally less than that of ocean freight, but can be greater. The actual balance depends on the country, suggesting an inland focus for trade-related infrastructure priorities for some countries. As land and labor costs rise near coasts in the People's Republic of China (PRC), investors are looking to locate production facilities farther inland but are hampered by poor infrastructure connections that raise trade costs to and from those areas. In particular, railway construction is crucial for inland provinces where a greater share of production is of bulk commodities.

The PRC has experienced fluctuating trends in freight and insurance costs for ocean trade but a steady decrease in those for air cargo. In 2002, the ad valorem costs of air freight and insurance fell below those of sea freight and insurance, and have remained lower since. Over the period from 1990 to 2004, the share of air cargo was relatively constant in terms of weight but about tripled in terms of value (Ma and Zhang, forthcoming).

2. Transportation and Complementary Infrastructure

Transportation infrastructure has the most direct impact on trade. Port efficiency has particular influence since the vast bulk of developing countries' trade (by weight) goes through seaports. A new harbor, wharf, or terminal, and procurement of a new crane decrease port costs by 2 percent and 1 percent, respectively (Haveman et al., forthcoming). Increasing the number of berths and deepening channels at ports have a smaller effect.

Capitalizing on the complementarities between different modes of transport can boost trade substantially. Airports and seaports can move more goods, particularly for containerized shipping, when served by efficient rail and road networks. Infrastructure behind the border can have as much effect on the length and variability of time-to-market as freight services between countries. This is particularly true in large or landlocked countries, where inland dry ports have evolved partly in response to this problem. Limao and Venables (2001) found that

domestic infrastructure explains only about 40 percent of transport costs for coastal countries, while for landlocked countries domestic and transit country infrastructure together account for 60 percent of transport costs. They also found that land transport is about seven times more costly than sea transport and that lowering a country's trade costs by 10 percent through infrastructure development could increase its exports by over 20 percent.

Telecommunications and information technology infrastructure reduce time costs, including search and border clearance costs. The quality of communication infrastructure services is correlated with the costs of entering into and monitoring contracts with suppliers. It also affects the costs related to the time elapsed between the perception of demand and subsequent supply of products to retailers (Nordas and Piermartini, 2004).

Fink et al. (2002) found that the cost of making a telephone call has a significant and negative impact on bilateral trade flows and a greater effect on trade of differentiated products than homogeneous ones. This highlights the value of information and communication technology (ICT) infrastructure at the dynamic, extensive margin of trade. And as the number of smaller shipments of a wider variety of higher value added products rises, ICT infrastructure services become more valuable and amenable to private sector financing. The same is true for trade in services as its growth outpaces that of goods. The main services traded (banking and business services, communications, etc.) require well-developed infrastructure in both exporting and importing countries.

3. Soft Infrastructure and Trade Costs

Soft (or institutional) infrastructure, such as predictable legal rights and procedures, enforceable competition policy, and a sound regulatory framework, is essential for physical infrastructure to function efficiently. Financial services, particularly long-term, local currency bond markets, play a central role in infrastructure financing. Reliability of trade facilitation and administrative procedures at customs is crucial, including rationalization of the customs transit system to reduce inspection time and simplify declarations and documentation.

In Indonesia, soft infrastructure limitations play a greater role than hard infrastructure limitations in constraining port efficiency. Lack of direct competition between ports controlled by the same government authority is also a factor (Patunru et al., forthcoming). In 2005 the ocean freight rate for importing a container to India was about two thirds *greater* than for exporting, while for importing to the PRC from six Asian countries it was far *lower* (De, forthcoming a). This may be because auxiliary shipping charges (documentation fees, container handling charges, government taxes and levies, etc.) can be greater than ocean freight charges, particularly where there is congestion.

Some infrastructure services, such as telephones, railways, and water supply systems, exhibit network externalities. Then the maximum amount a consumer is willing to pay depends on the

number of other users, possibly leading to monopolies and calling for enforcement of competition policy. The Republic of Korea has achieved one of the highest rates of broadband Internet penetration at competitive prices by carefully balancing the technical advantages of network infrastructure with the efficiency advantages of competition.

4. Efficiency, Comparative Advantage, and Production Fragmentation

Infrastructure influences not only absolute advantage, but also comparative advantage. Patterns of specialization and trade are partly determined by infrastructure service quality. Limitations in factor endowments may be mitigated by infrastructure services, also affecting the dynamics of comparative advantage, as services may be either complements or substitutes for physical inputs.

As infrastructure expanded in East Asia, trade costs fell and altered countries' comparative advantages, enabling greater fragmentation of production supply chains and intraregional trade in parts and components. The subsequent economic integration is markedly higher than in other developing regions (Table 1).

Table 1: Interregional Comparisons

		Africa	East Asia	South Asia	Latin America and Caribbean
Merchandise trade (% of GDP)	2005	57.8	74.6	31.2	44.2
Intra-regional trade shares (%)	2003	12.2	55.0	6.0	15.0
Infrastructure					
Electricity consumption (kWh per capita)	2003	513.0	1,184.3	393.9	1,614.5
Fixed line and mobile subscribers (per 1,000)	2004	90.6	431.7	75.3	496.0
Internet users (per 1,000)	2005	29.0	88.6	49.0	156.1
Electric power transmission and distribution losses (% of output)	2003	12.0	7.3	26.4	16.1
Paved roads (% of total)	1999–2003	12.5	32.3	53.9	26.8

Source: *World Bank, World Development Indicators 2007.*

When the production process is increasingly fragmented and dispersed, infrastructure services that ensure timeliness and reliability of delivery become even more critical. Again, East Asia's performance is better than other developing regions (Table 2).

Table 2: Border Trade Costs

	Sub-Saharan Africa	East Asia and Pacific	South Asia	Latin America and Caribbean
Export documents (#)	8.2	6.9	8.1	7.3
Time to export (days)	40	23.9	34.4	22.2
Cost to export (US$ per container)	1,561	885	1,236	1,068
Import documents (#)	12.2	9.3	12.5	9.5
Time to import (days)	51.5	25.9	41.5	27.9
Cost to import (US$ per container)	1,947	1,037	1,495	1,226

Source: *World Bank, Doing Business 2007.*

Tham et al. (forthcoming) show that foreign firms are interested in Malaysia as a key link in global supply chains due to its locational advantages, which, in turn, are closely linked to its infrastructure quality. Amiti and Javorcik (2008) find that market and supplier access are the most important factors affecting foreign investment, with an effect on location choice about four times as great as production costs. For foreign investors in the PRC, access to markets and suppliers within the province of entry matters more than access to the rest of the country.

Seaport competitiveness may suffer from inadequate channel depth, shortage of berths, and limited cargo handling equipment, storage and transit areas. It may also suffer from limitations in soft infrastructure, such as labor skills, regulation, bureaucracy, and other factors affecting capacity utilization. Improvements in infrastructure service efficiency can lead to cost savings equivalent to those accruing from moving production to locations thousands of kilometers closer to trading partners. They can also serve to attract foreign direct investment.

When growth is very rapid, congestion may result as traffic growth outpaces capacity. This is occurring in the PRC, where six percent of the world's rail lines struggle to move one fourth of the world's rail freight and only two percent of the country's highway network is made up by expressways. Port congestion has been rising, most notably at Shanghai, as physical infrastructure is overloaded and collaboration is lacking among different stakeholders to achieve greater port efficiency (Ma and Zhang, forthcoming). For South Asia, De (forthcoming b) finds that inland transport accounts for 88 percent of overall trade transportation

costs. Land border crossings are overcrowded and complex requirements in cross-border trade raise possibilities for corruption and informal trade. Policy reform to reduce border delays and monetary costs could increase competitiveness substantially.

5. Regional Cooperation in Trade-Related Infrastructure

The impacts of trade-related infrastructure can be leveraged by coordination across borders, taking advantage of economies of scope and scale to facilitate trade expansion. In the Greater Mekong Subregion, special forums coordinate transport, telecommunications, and electric power infrastructure developments, particularly for cross-country economic corridors.

In the international context, harmonized and coordinated soft infrastructure will complement physical infrastructure connections. Supported by a conducive policy environment that capitalizes on regional externalities through cooperative arrangements, enhanced infrastructure services can reduce trade costs and facilitate trade expansion, regional integration, and economic development.

6. Concluding Remarks

Trade has played an important role in Asia's economic re-emergence and infrastructure has played an important role in facilitating trade by lowering trade costs and influencing comparative advantage and competitiveness. The shift toward lower weight-value ratios of traded goods and increased value of timely delivery has implications for infrastructure investments and expansion. Notably, the development of physical infrastructure should be complemented by improvements in supporting institutions.

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About this Research Policy Brief

Infrastructure has played a key role in Asia's export-led rapid growth, but the details of that contribution are poorly understood even though infrastructure accounts for huge amounts of investment. This policy brief examines and, where possible, quantifies the role of hard and soft infrastructure in reducing Asia's trade costs and thereby influencing trade flows and patterns.

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The Asian Development Bank Institute (ADBI), located in Tokyo, is a subsidiary of the Asian Development Bank (ADB). It was established in December 1997 to respond to two needs of developing member countries: identification of effective development strategies and improvement of the capacity for sound development management of agencies and organizations in developing member countries. As a provider of knowledge for development and a training center, ADBI serves a region stretching from the Caucasus to the Pacific islands.

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