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**Regional Cooperation, Infrastructure, and Trade Costs in
Asia**

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Douglas H. Brooks is a senior research fellow at the Asian Development Bank Institute (ADBI).

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Abstract

International trade has played an essential role in Asia's remarkable growth, development, and integration in recent decades. Infrastructure, both hard and soft, has played an integral part in facilitating that trade, primarily through reducing the associated transaction costs. Regional coordination and cooperation can help to reduce negative externalities from trade and to capitalize more fully on positive spillover effects. This study explores the nexus between Asia's trade flows and patterns, trade costs and how they are influenced by infrastructure development, and the role of regional cooperation in facilitating trade's contribution to economic integration. A virtuous circle between growth, infrastructure investment, trade expansion, and regional integration is elucidated.

JEL Classification: F15, F13, O19

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I. INTRODUCTION

The remarkable growth of developing Asia in recent decades owes much to the expansion of its international trade, including intraregional trade. To capitalize on the benefits of international trade, cooperative efforts in the region to lower transaction costs of international (and especially intraregional) trade and thereby contribute to greater growth, integration, and poverty alleviation have become more vigorous in recent years. Notably, international trade played an especially critical role as Asian countries pursued regional cooperation to ensure recovery from the 1997–98 financial crisis and prevention or mitigation of similar crises in the future.

Infrastructure development has been a major factor in reducing Asia's trade costs and thereby facilitating trade expansion (Brooks and Hummels forthcoming 2009). Expansion or improvement in quality of infrastructure services lowers marginal costs, raising the minimum efficient scale of production, transportation, or marketing. Lower costs and greater economies of scale raise the potential for increased or new sales in export markets, as well as domestically, as efforts to take advantage of economies of scale in production, procurement, or marketing lead firms to look beyond national borders for both trade and investment opportunities. Promoting efficient financial intermediation, coordinating regional public goods, reducing macroeconomic vulnerability to shocks, and strengthening security ties offer governments similar incentives to design, develop, and manage regional infrastructure cooperation and integration. In this context, infrastructure is one of the "three I's," along with incentives and institutions, that are key determinants of overall growth and the magnitude and productivity of capital inflows to liberalizing economies (Hill 2004).

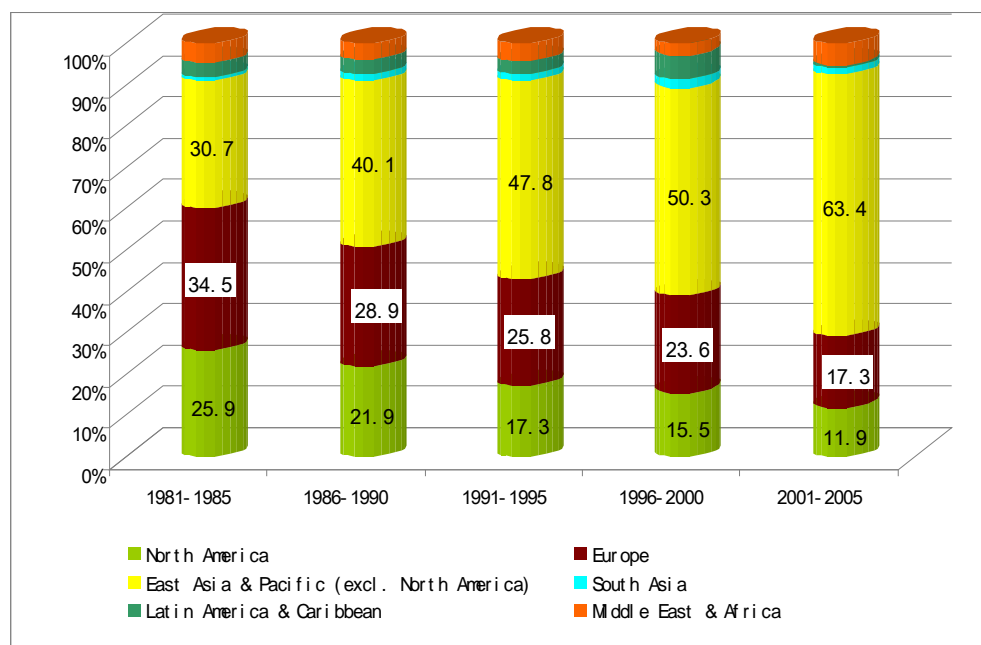
Infrastructure not only fosters economic growth, but can strengthen inclusiveness and reduce poverty, and a significant part of infrastructure's contribution to growth and poverty reduction in Asia comes through its facilitation of international and especially intraregional trade. Infrastructure services expand the scope for both domestic absorption and supply to export markets, while stimulating linkages with and between different sectors and industries and providing incentives for innovation and regional cooperation to internalize externalities associated with trade flows.

Efficient infrastructure services increase and expand linkages to global supply chains and distribution networks for producers by lowering transaction costs, raising value added and increasing potential profitability. The more deeply a country is involved in global production networks the more likely it will benefit from trade-related infrastructure investment. In a study incorporating threshold effects, Francois and Manchin (2007) find that infrastructure is a significant determinant not only of export levels, but also of the likelihood of exporting at all. Transport and telecommunications infrastructure are particularly important in this regard.

Clearly, Asia's trade expansion has been facilitated and stimulated by the development of supporting infrastructure, including both physical (hard) and institutional (soft) infrastructure. From 1975 to 1995, developing Asia's port capacity increased from 3 million to 62 million TEU, an average annual growth of over 15% and Asia now accounts for the bulk of port container traffic (Figure 1).¹ Airfreight shipments in the region increased roughly 14% annually during the same period, from less than 2 billion to more than 30 billion ton-kilometers.

¹ TEU represents "twenty-foot equivalent unit," a standard measure of shipping capacity based on a typical container size.

Figure 1: Shares of Port Container Traffic among Regions (%)

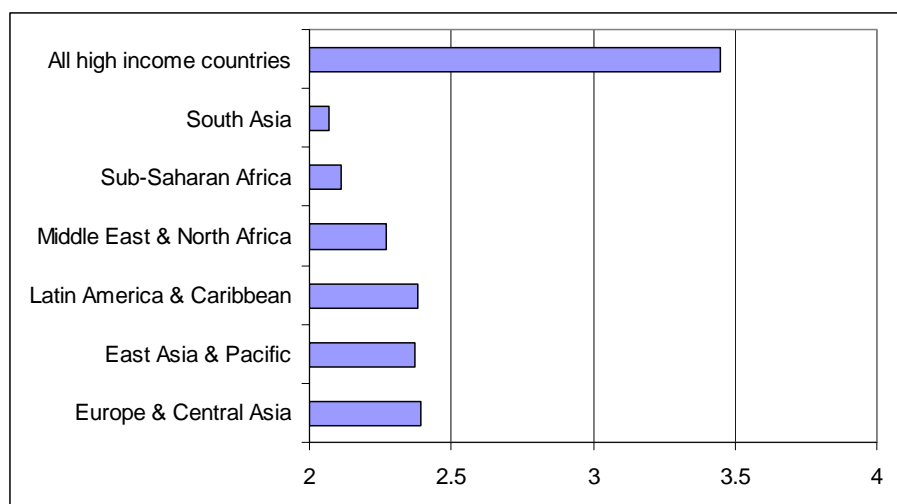


Notes: Shares are calculated using the container traffic (TEU) of the top 100 ports for the period 1981–2000 and the top 50 ports for the period 2001–2005.

Data source: Shipping Statistics Yearbook and Containerisation International Yearbooks.

Asia's large trade and foreign investment flows have resulted from infrastructure development, market-driven integration, outward-oriented policies, and incorporation into international production networks and regional cooperation frameworks. Openness to foreign direct investment (FDI), often from within the region, has become the norm. As a result, investment in infrastructure to lower trade costs has been complemented and spurred by foreign and domestic investment in productive capacity as well as by structural and regional reforms that improve the environment for investment, production, and trade. Both Asian and non-Asian multinational corporations have been active in developing international supply chains linking different parts of the region. Financial integration has supported these developments by increasing access to credit and innovative financial instruments.

However, trade-related infrastructure in many Asian countries is still inefficient, if not inadequate. Inability to transport goods and people efficiently or an inadequate power supply to operate machinery and facilities smoothly leads to microeconomic as well as macroeconomic imbalances. While East Asia does relatively well in comparison of its infrastructure performance with that in other developing regions, comparison with high income countries shows there is still marked room for improvement, and even more so in South Asia (Figure 2).

Figure 2: Infrastructure Performance Index

Source: World Bank 2007.

Tariffs and quotas have been reduced under successive rounds of multilateral negotiations under the General Agreement on Tariffs and Trade (succeeded by the World Trade Organization) and the recent plethora of bilateral and regional trade agreements, lowering a key component of trade costs. Anderson and van Wincoop (2004) suggest that such tariff barriers are on average between 10% and 20% of a traded product's factory-gate price in developing countries. In developing countries it may well be higher. Even so, in the current economic environment, infrastructure-induced reductions in trade costs have become relatively more important than direct policy barriers as potential sources of further cost savings (Brooks, Roland-Holst, and Zhai 2005). However, the political economy of policies to reduce transportation and other non-policy trade costs is very complex, particularly when addressing cross-border externalities.

II. REGIONAL COOPERATION AND TRADE-RELATED INFRASTRUCTURE

Infrastructure services can yield a variety of externalities. For example, developing a new road infrastructure project to relieve congestion in accessing ports produces advantages not only for the direct users of the road project but also for users of other roads where congestion is lessened as a result of the new project. Even those who do not use the new road or alternatives can gain through reduction of pollution and improvement of the natural environment, and the country as a whole can benefit through reduction of oil consumption or oil imports as well as increased trade benefits.

Regional cooperation through international trade strengthens regional economic growth and integration, allowing greater regional investment in trade-related infrastructure projects. At the same time, the international externalities that arise as infrastructure services support cross-border trade flows indicate an important role for regional cooperation to incorporate those externalities and maximize social benefits (Maur 2008).

As infrastructure investment facilitates regional economic integration through trade and investment expansion, it motivates regional cooperation, including cooperation in infrastructure development, generating a virtuous cycle. The diversity of Asian economies, combined with infrastructure expansion and improvement to lower trade costs, has helped the region to benefit as a leader in global patterns of production fragmentation, expanding intraregional trade, and diversification of development opportunities.

As production services become increasingly fragmented and traded internationally, cooperation among the economies participating in those production networks becomes more and more important to maintain or raise an individual host country industry's competitiveness in supplying those services. Regional coordination can lower infrastructure construction, maintenance, and operating costs and limit resulting environmental and other negative social impacts while still contributing to trade expansion. This has been found to be the case in the Greater Mekong Subregion (GMS) where special forums have been established to coordinate transport, telecommunications, and electric power infrastructure developments, particularly for the development of cross-country economic corridors (Asian Development Bank (ADB) 2006).

Weiss (2008) describes a framework for considering the role of infrastructure in regional cooperation. He utilizes a modified formulation of the effective rate of protection to quantify the empirical significance of a range of trade cost barriers that are broader than tariffs and quotas. Infrastructure investments and interventions are then seen to be instruments that reduce trade costs and thereby stimulate closer intraregional and interregional trading linkages. In this manner, the height of barriers posed by different types of trade costs offers a rough ranking of priorities for infrastructure development to reduce these barriers.

Factors like high freight costs, delays in customs clearance, unofficial payment solicitations, slow port loading or landing and handling, and poor governance create barriers to trade. Institutional bottlenecks (administrative, legal, financial, regulatory, and other logistics infrastructure), information asymmetries, and discretionary powers that give rise to rent seeking activities by government officials at various steps of trade transactions also impose costs. These costs can be lowered through cooperation that facilitates merchandise and services trade logistics, for both inbound and outbound shipments.

At the international level, cooperation through preferential trade and investment agreements that strengthen structural reforms and increase the attractiveness of a destination for foreign investment can leverage domestic policy actions and impact on growth, equity and efficiency, and may help to reduce corruption. Cross-border cooperation in infrastructure policies and institutions can therefore lead synergistically to a reduction in trade costs and stimulate further investment, trade, and growth.

III. SOFT INFRASTRUCTURE

While trade infrastructure often evokes images of large-scale physical projects, institutional (or soft) infrastructure is equally important. A supporting environment of predictable legal and judicial rights and procedures, equitable and enforceable competition policy, and a sound but not unduly restrictive regulatory framework are crucial for physical infrastructure investment to be efficient. Financial services, including financial intermediation, risk management opportunities, and payment and clearing services are especially important for international trade. International bond markets capable of supplying long term finance in local currencies play a central role in infrastructure finance, but are still in an early stage of development in most of Asia. Cooperative efforts are underway to broaden, deepen, and strengthen these markets throughout the region, in part to support greater trade.

Regional cooperation activities aimed at facilitating international trade work particularly well when targeted at soft infrastructure. These activities include (among others) enhancing availability of adequate credit and foreign exchange at reasonable rates, a reliable system of legal recourse and dispute resolution, effective competition policy, and the capacity of existing human capital to process exchanges. Indeed, soft infrastructure may often be more important than physical infrastructure for increasing trade and its profitability, and equitably distributing the benefits. In the international context, the role of harmonizing and strengthening soft infrastructure stands out as an essential partner of expanded physical infrastructure.

Infrastructure improvements generally have the positive effect on competition of applying equally to both foreign and domestic entrants. This is particularly true when infrastructure improvements are complemented by effective competition policy that constrains monopoly power and removes barriers to entry within the region (Brooks 2005). Regional cooperation can help to maximize the benefits from balancing agglomeration effects with international competition's efficiency gains.

Exploiting complementarity of hard and soft infrastructure raises overall trade and economic performance. This is especially noticeable in the case of networks. Many infrastructure services that are important for economic development and trade expansion exhibit network externalities. Infrastructure networks exhibiting service externalities include telephones, railways, and water supply systems (see Laffont and Tirole 2000). In the presence of such externalities, the maximum amount that consumers are willing to pay for a good or service depends in part on the number of other consumers who purchase the item in question. This interrelationship calls for consideration of these network systems' governance in competition policy. As one example, Republic of Korea has achieved one of the highest rates of broadband internet penetration at competitive prices by balancing the technical advantages of network infrastructure with the efficiency advantages of competition.

In the case of Indonesia, Patunru, Nurridzki, and Rivayani (forthcoming 2009) find that soft infrastructure plays a vital role in relieving constraints on port efficiency, more so than hard infrastructure although the two are interlinked. The competitiveness of a seaport as a regional hub may suffer from poor physical infrastructure such as inadequate channel depth, shortage of berths, and limited cargo handling equipment, storage and transit areas. But it may also suffer from limitations in soft infrastructure, such as weak labor skills, inadequate regulation, stifling bureaucracy, and other institutional factors affecting port capacity utilization, such as rigidities in existing patterns of regional shipping routes. Lack of direct competition between ports controlled by the same government authority is also a critical, related factor.

While difficult to quantify, governance is a critical aspect of soft infrastructure. Definitions vary, but governance can be thought of as the institutions and processes by which collective decisions are made and problems are solved. Khan (2008) provides a framework for considering how governance, and soft infrastructure in general, can contribute to lowering trade costs and strengthening regional cooperation in developing Asia, applying a modified form of the effective rate of protection. Comparing the height of different trade cost barriers with this formulation again allows a rough ranking of priorities for undertaking potential soft infrastructure interventions at both the national and regional level.

IV. INFRASTRUCTURE AND TRADE COSTS

Both the quantity of infrastructure investment and the quality of infrastructure services influence trade performance (see e.g., Limao and Venables 2001; Clark et al. 2004). This occurs through infrastructure's impacts on monetary transaction costs, loss, damage and spoilage to goods in transit, and timeliness of delivery, among other factors.

Nordas and Piermartini (2004) delineate four dimensions of the relationship between infrastructure and trade transaction costs:

1. *Direct monetary outlays* for delivering traded goods are partly determined by the quality of infrastructure and the cost and quality of related services.
2. *Timeliness*, even more than freight rates, is likely to be influenced by geography and infrastructure.
3. *Risk* of damage, losses, or larger insurance costs is higher when infrastructure is of poor quality.

4. *Lack of access* to a good transport or telecommunication service can have a high opportunity cost, restricting market access and limiting the likelihood of participating fully in the benefits of trade.

An important component of transportation costs is the time cost involved. This is particularly critical for perishable or other time-sensitive goods. Hummels (2001) found that the time cost of one day in transit for US imports is equivalent to an ad valorem tariff rate of 0.8%, implying the equivalent of a 16% tariff on an average ocean shipment of 20 days. Clearly, improvements in infrastructure services that reduce delays in ports, border crossing procedures, or transit times will influence a country's propensity to trade. Developments in containerization and intermodal transport networks contribute to quicker delivery times and the growth in air shipments.

With the value of timeliness in delivery rising in recent decades, congestion is becoming increasingly costly. When growth is very rapid, congestion results as the increase in traffic induced by the economic growth outpaces the expansion of transportation infrastructure services. Ma and Zhang (forthcoming 2009) find this to be the situation in the People's Republic of China (PRC). Sea port congestion there results from the long neglect of access transport and port facilities infrastructure. Six percent of the world's rail lines struggle to move one-fourth of the world's rail freight turnover, and only 2% of the country's highway network is expressways.

Congestion has been rising, notably at the port of Shanghai, as overloading of the physical infrastructure is compounded by a lack of collaboration among different stakeholders at the port in achieving greater levels of supply chain efficiency. This reinforces the drive to increase port and modal competition for greater gains in efficiency by increasing both hard and, increasingly, soft infrastructure. In terms of soft infrastructure, reliability of trade facilitation and administrative procedures at customs are crucial, including rationalization of the customs transit system in order to reduce inspection time and simplify declarations and the documentation process. Meanwhile, Shanghai's congestion is reducing its competitiveness relative to nearby ports in neighboring economies, endangering its status as a hub and premier gateway to international markets and suppliers. In recent years, transshipped containers from Shanghai via Hong Kong, China have accounted for as much as 20% of the total container throughput of Shanghai.

The limited extent of infrastructure connections to western regions of the PRC results in high trade costs for inland regions and impedes regionally balanced growth. As land and labor costs rise near coasts, investors are looking to locate production facilities farther inland. However, they are hampered by poor infrastructure. This has led to a shift of emphasis in infrastructure policy that gives greater weight to hinterland access. In particular, railway construction is crucial for inland provinces, where a greater share of production is of bulk commodities.

The composition of freight charges can vary significantly across countries and commodity categories. De (forthcoming 2009a) finds that the share of Asia's total freight charges accounted for by inland freight may be less than that by ocean freight, but is frequently greater. The actual balance depends on country characteristics, suggesting an inland focus for trade-related infrastructure priorities in those countries where the inland share is greater and there is a role for regional cooperation in incorporating landlocked countries into international trade patterns. From 2000 to 2005, transport costs became relatively higher and shipping distance relatively lower, and a 10% rise in transport costs (expressed as an ad valorem tax equivalent) is found to lower Asia's trade by about 3%–4% from what it would otherwise be. When trade is differentiated by commodity groups, the weight to value ratio is found to be the major determinant of transport cost, suggesting that road, rail, and sea may be the increasing order of modal preference for transporting heavier cargos in Asia.

Hummels and Skiba (2004) similarly found that a 10% increase in the ratio of product weight to value leads to a 4% increase in ad valorem shipping costs, reflecting the demand for

higher value cargos. From the consumer's point of view, higher shipping costs can reflect a smaller ad valorem charge in the final price paid, so the consumer is more likely to use more expensive modes of shipping when the impact on the delivered price is smaller.

The relative weights of different categories of trade costs are often surprising. In the same study De notes that in 2005 the ocean freight rate for importing a container to India was about two thirds *greater* than for exporting. At the same time, in the PRC ocean freight for importing a container from six Asian countries was far *lower* than for exporting. Auxiliary shipping charges (documentation fees, container handling charges, government taxes and levies, etc.) may account for much of this difference and are sometimes greater than the ocean freight charges, particularly where shipments experience congestion at ports or borders. On average, auxiliary shipping charges outweigh terminal handling charges across countries and commodities in Asia, with variation in such charges contributing significantly to variations in trade costs. This highlights one crucial area of soft infrastructure's potential contributions to lowering trade costs.

Domestic 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 especially true in large or landlocked countries, and the proliferation of inland dry ports has evolved partly in response to this problem. Limao and Venables (2001) found that domestic infrastructure explains about 40% of transport costs for coastal countries, while domestic and transit country infrastructure together account for an estimated 60% of transport costs for landlocked countries. Furthermore, land transport is about seven times more costly than sea transport over similar distances, and estimates of the elasticity of trade flows with respect to transport costs range from -2 to -3.5, suggesting that lowering a country's trade costs by 10% through infrastructure development could increase its exports by over 20%.

De (forthcoming 2009b) finds that inland transport cost is the major component, accounting for about 88%, of overall trade transportation costs in South Asia. Inland costs are very high across South Asian countries, except in Sri Lanka, and vary across goods and countries, being even higher when countries are landlocked. Land border crossings are overcrowded, and greater policy attention to efficiency concerns could easily reduce delays and monetary costs. Complex border-crossing requirements in trade expand possibilities for corruption and have encouraged sharp growth in informal trade. The magnitude of border effects in South Asia argues strongly for improvements in soft infrastructure, complemented by inland transportation infrastructure, to raise the competitiveness of the sub-region's exporters.

V. EMPIRICAL ESTIMATES OF TRADE COSTS

Empirical assessments of trade costs are most frequently derived through estimation of a gravity equation, and an excellent survey of estimating trade costs can be found in Anderson and van Wincoop (2004). They estimated that the tax equivalent of representative international trade costs is as high as 74% for industrialized countries, including 21% transportation costs and 44% border-related costs.² Costs for developing countries can be much higher.

De (2008) estimates a modified gravity equation for eight sectors in 10 Asian countries, controlling for distance, to examine the effects of both policy and non-policy barriers to trade. Infrastructure quality and transport costs, along with tariffs, are found to be the main determinants for cross-country variations in Asia's trade flows. Infrastructure interventions that reduce the costs of international transport and trade are therefore seen to be crucial for the region to fully realize the gains from recent and prospective trade policy liberalization reforms.

² The costs are not simply additive. The total is $1.44 \times 1.21 - 1 = 0.74$.

There is often skepticism as to whether the benefits of trade-related infrastructure investment in developing countries accrue proportionately to the poor. Large scale infrastructure projects are frequently viewed as mainly benefiting large firms, whether those are domestically or foreign owned. The poor, who are often also the most deprived of infrastructure services, are often considered to be secondary beneficiaries, if indeed any benefits extend to them at all.

Menon and Warr (2008) examine the impacts of road improvement in Lao People's Democratic Republic (Lao PDR), a poor, land-locked country. Lao PDR has a rugged, mountainous terrain and generally low quality roads. The poorest people often reside far from urban centers and are the most disadvantaged by the high transport costs that result from bad roads. Over the past two decades Lao PDR has made substantial progress in reforming legal and administrative obstacles to market-based development and in opening to trade with the outside world, but these reforms in soft infrastructure may be of limited value for producers facing very high transport costs arising from inadequate market access due to physical infrastructure constraints. Inadequate or substandard roads remain a stubborn obstacle to realizing the potential benefits from international trade for rural residents.

In this context, Menon and Warr use a general equilibrium modeling approach to assess the impact of rural road improvement on the incidence of poverty. Differentiating rural villages into three categories according to the quality of road access available: (i) no vehicular access, (ii) dry season only access, and (iii) all weather access, they find that although improvement in roads in all three categories reduces poverty, the type of road improvement is critical in determining the magnitude of the impact. For instance, when areas with no vehicle access are provided with dry season access roads, the reduction in poverty incidence is about 17 times that which occurs when upgrading from roads suitable only for dry season access to all weather access roads. And the effect on Gross Domestic Product (GDP) is about six times as great. In this context, enabling transport of traded goods for households without initial road access is highly pro-poor compared with road improvement for households already having dry season road access to markets. Extending the access from this land-locked economy further to overseas markets depends on the cooperative efforts in the GMS.

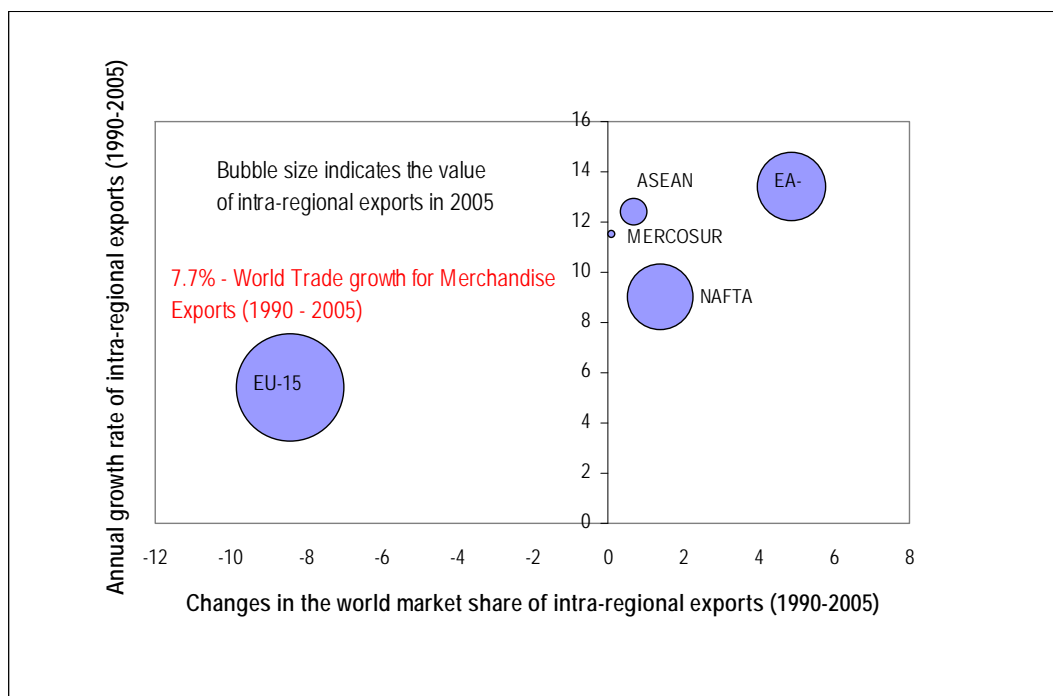
Edmonds and Fujimura (2008) investigate the impacts of infrastructure development on trade and Foreign Direct Investment (FDI) in the GMS, focusing on both domestic and cross-border infrastructure. The way in which road infrastructure, whether domestic or cross border, affects trade directly is clear and operates mainly through reductions in transport costs. These same reductions in transport costs also underlie the impacts on poverty. Furthermore, reductions in transport costs have an indirect positive effect on FDI inflows by reducing transaction costs in intra-firm vertical integration across countries designed to exploit comparative cost advantages. Increases in FDI, in turn, can further increase regional trade, and add to the direct effect of reduced transport costs achieved through improvements in road infrastructure near border areas. When such gains are present, this reduces tendencies towards production agglomeration. If the advantages of production integration across economies outweigh those from agglomeration, then reductions in transport costs make FDI complementary to trade. This defines a virtuous cycle of trade and investment to lower trade costs that fosters increased trade and economic growth.

To explore this, Edmonds and Fujimura estimate gravity models using panel data from 1981 to 2003 for trade and FDI flows between each pair of the six GMS countries. The results show that the quality of road infrastructure in border areas between economies has a positive and statistically significant relationship with trade flows between them, and that this relationship is particularly strong when both cross-border and domestic road infrastructure are included in the estimates. They also find that cross-border road infrastructure has effects distinct from domestic roads, suggesting that investments in cross-border infrastructure have an independent and important role to play in the promotion of regional trade.

VI. TRADE COSTS AND TRADE PATTERNS

A notable feature of developing Asia's intraregional trade is the growing volume of shipments of parts and components across national borders. Fragmentation of production supply chains and sourcing raw and intermediate inputs from wherever costs (including related trade costs) are lowest has yielded benefits for both producers and consumers, as well as tax revenues for government budgets. At the same time, the double (or triple) shipping it involves puts greater strain on existing trade-related infrastructure and raises the demand for timely delivery and greater information on shipping status enroute. To compete for larger shares in these benefits, countries have been striving to lower their costs by increasing the quantity and quality of services to support the production, distribution, and international trade of a widening array of intermediate goods and services.

Figure 3: Intra-regional Trade of Major Regions 1990–2005



Data source: Direction of Trade Statistics 2007 and UN COMTRADE data base.

As infrastructure expanded in Asia, particularly in East Asia, trade costs fell and altered the comparative advantages of countries in the region, making greater fragmentation of production supply chains possible and spurring the region's intraregional trade in intermediate products. The subsequent economic integration in East Asia is sharply higher than in other developing regions (Figure 3). When inputs are being sourced from wherever costs are lowest and the production process increasingly dispersed geographically, then timeliness and reliability of delivery become critical factors and the influence of both physical and institutional infrastructure services at the regional level is even more apparent. In this context of production fragmentation, East Asia's performance in reducing border trade costs stands out again relative to other developing regions (Table 1).

Table 1: Border Trade Costs

	Sub-Saharan Africa	East Asia & Pacific	South Asia	Latin America & Caribbean
Documents for export (number)	8.2	6.9	8.1	7.3
Time for export (days)	40	23.9	34.4	22.2
Cost to export (US\$ per container)	1,561	885	1,236	1,068
Documents for import (number)	12.2	9.3	12.5	9.5
Time for 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.

Infrastructure influences not only absolute, but comparative, advantage. Differences between countries in the quality of infrastructure services help to explain differences in total factor productivity. These impacts on productivity vary across sectors, depending on how intensively each sector uses infrastructure services and how reliant it is on the quality of infrastructure services (and the availability of technology for alternative production processes). Thus, patterns of specialization and trade are determined in part by the influence of infrastructure service quantity and quality on comparative advantage. Hummels and Skiba (2004) estimate that a 10% increase in product price leads to an 8.6% fall in the ad-valorem transport cost. Thus, transportation costs alter the relative prices of different quality goods, indirectly changing the composition of trade.

Limitations in factor endowments may be mitigated by infrastructure services, also affecting the dynamics of comparative advantage. In different production processes, infrastructure services may serve either as complements to, or substitutes for, physical inputs. The significance of factor endowments in determining comparative advantage may thus be modified by infrastructure development (Brooks and Leuterio 1997; Yeaple and Golub 2002).

Hummels (forthcoming 2009) looks at four types of recent changes in the composition of trade and their effects on demand for transportation: (1) changes in the ratio of weight to value of traded goods, (2) demand for timeliness and the shift towards increased air shipping, (3) new trade flows (both of products and geographical routes) and variation in the size of shipments, and (4) production fragmentation. The relationships are complex since the developments are interlinked. For example, declining weight/value ratios and vertical specialization in the fragmentation of new production supply chains generate new trade flows and patterns which have spurred the rapid growth in Asian air cargo shipments.

When infrastructure development lowers the marginal cost of trade, there can be increases in exports at both the extensive and intensive margins. The expansion at the extensive margin (of new products, to new destinations), typically through small shipments from small firms, influences the types of infrastructure services demanded differently than does the deepening of existing trade flows. This is especially true for transportation infrastructure demand. When the new markets are inland, air transport may be a viable alternative to a combination of sea and land freight to avoid and reduce potential port congestion, noting that the shipping time savings are positively correlated with the shipping distances involved.

The surge in oil prices during 2008 raised shipping (and therefore import) costs, shifting the balance in favor of domestic producers and inflation. Changes such as this can have a double or greater impact on products in international supply chains as both imported inputs and exported final products register higher prices. For example, Chinese steel produced with iron ore imported from Brazil and exported to the US was hit twice by higher fuel charges. The impact is obviously greater where the goods (or their imported components) are shipped

by air or have a high weight-to-value ratio and therefore where fuel accounts for a higher share of freight costs. The demand for modal switching places a premium on interoperability, an area where smoother regional connections and harmonization of standards can make a large difference in competitiveness.

Malaysia is a prime example of a country where the government has actively promoted infrastructure development in order to strengthen its competitive and comparative advantage. Since the mid-1980s, Malaysia has pursued an FDI-led, export-oriented development strategy, with FDI contributing to the economy's integration into global production networks. As Tham, Devadason, and Heng (forthcoming 2009) point out, foreign firms' interest in Malaysia as a key link in global and regional supply chains has been piqued by the country's competitive locational advantages, which in turn are closely linked to its infrastructure development and resulting high quality services.

Tham et al. illuminate the role of infrastructure in attracting export-oriented FDI through observing FDI's sectoral and locational pattern and through interviews with managers of local subsidiaries of foreign firms involved in international trade. The location of FDI is found to be biased toward areas with relatively good infrastructure and amenities, as could be expected. Thus, infrastructure improvements increase the chances of attracting foreign direct investment, which in Malaysia as well as other areas in Asia has frequently been directed toward export sectors, and therefore also influence patterns and quantities of imported raw materials and intermediate inputs.

Amiti and Javorcik (2006) find that market and supplier access are the most important factors affecting foreign investors' entry into an economy, and have about four times as great an effect on the choice of foreign investment location as do production costs. In particular they find that in PRC, access to markets and suppliers within the province of entry matters more than access to those in the rest of the country, consistent with observed market fragmentation. An increase in trade-related infrastructure of one standard deviation in the number of sea berths is found to result in an increase of foreign entry by about 11%, while a one standard deviation increase in the length of rail lines increases it by 7%. This supports the observation that provinces with more developed ports, and to a lesser extent a more developed rail network, tend to attract greater FDI inflows. Over time, however, related factors such as congestion, security concerns, connectivity of airports, and delays in processing trade documentation may reduce the positive impact of infrastructure on lowering trade costs for foreign investors.

VII. TRADE FACILITATION

Reductions in trade costs resulting from infrastructure improvements or expansion are one form of trade facilitation, but trade facilitation through cost reduction can take a variety of forms. In the context of the World Trade Organization, it primarily refers to simplifying or speeding up administrative documentation procedures at border crossings. In broader usage, it includes various measures taken by public and private sectors, reform of non-tariff measures, and physical efforts to facilitate trade by reducing time in transit.

Dee, Findlay, and Pomfret (2008) include in the scope of trade facilitation all factors affecting the time and money cost of moving goods across international borders. Implementation options, including institutional arrangements and particularly regional agreements, can be usefully considered. The success of reforms to facilitate trade depends on their impact on reducing both rent-creating and cost-creating influences. These can be distinguished through use of the price-cost margin as a performance measure to help identify rent-creating barriers, and use of cost or productivity as performance measures to identify cost-creating barriers. The identification is important since the treatment effect (for rent-raising or cost-raising) can dominate other factors in the estimated height of trade barriers, with consequent policy implications. The extent to which non-tariff barriers, such as regulations, lead to

vertical shifts in demand or supply curves with resulting effects on costs and prices can be quantified through antimonopoly estimation, in which a measure of economic performance is also estimated for the counterfactual case with no non-tariff barriers in a market.

The ability of a nation to finance trade-related infrastructure projects is complicated by the dynamics of trade balances, debt, and reserve accumulation, among other factors that constitute important feedback loops between trade and infrastructure. Demographics, government debt levels, and intergenerational equity are all relevant concerns in the decision making process for infrastructure expansion and financing. Consequently, the modality chosen for financing trade-related infrastructure can have macroeconomic implications which vary depending upon initial conditions (Brooks and Zhai 2008).

Most physical infrastructure outlays are accounted for by public investment, particularly where fixed network infrastructure has public good and natural monopoly characteristics. Francois and Manchin (2007) illustrate the complementarity between greater government involvement, domestic transport and communications infrastructure, and export performance.

Interactions between changes in the composition of trade, mode of product packing (container or bulk, for example), and the capacity expansion effect of new port infrastructure all influence the potential profitability, and hence bankability, of port infrastructure investments. Ocean shipping constitutes 99% of world trade by weight and a majority of world trade by value (Hummels 2007). In planning projects for port expansion or improvement, both the capacity and efficiency effects need to be taken into account when projecting potential benefits. This is true for all modes of transport, through sea-, dry-, and airports, and can have important implications for regional partners and competitors.

Among different indicators of infrastructure services' contributions to trade, port efficiency appears to have the largest influence, reflecting the fact that the vast bulk of developing countries' trade (by weight) goes through sea ports. For example, infrastructure improvements that raise port efficiency from the 25th to the 75th percentile can reduce shipping costs by more than 10% (Clark, Dollar, and Micco 2004). The dominance of sea freight over land transport, and its associated cost savings, emphasizes the need to address, particularly through regional cooperation, the challenges faced by landlocked countries attempting to compete in global markets as well as the importance of improving port efficiency in countries with amenable coastal areas.

Haveman, Ardelean, and Thornberg (forthcoming 2009) confirm through econometric estimation for a subsample of Asian ports that specific types of infrastructure investments are highly correlated with reductions in port costs. While Penang (Malaysia) currently has the lowest costs of ports studied, between 1997 and 2005 Mumbai experienced the greatest improvement in relative costs. Operating with a new harbor, wharf, or terminal is found to decrease port costs by 2%, while procurement of a new crane is found to decrease port costs by 1%. Increasing the number of berths and deepening channels at ports have less effect.

Not only do investments in port infrastructure, and especially the procurement of new cranes, lower costs and raise efficiency for current trade flows, they can also increase port capacity to handle new flows and influence the composition of trade. Port costs vary significantly across products even at a single port and new infrastructure can, for example, differentially influence the costs for loading/unloading containers versus bulk commodities. Given the inherent advantages in containerization for certain product categories, relevant port infrastructure developments can reduce unit costs further as the container share of trade rises.

Information and communication technology (ICT) is a highly productive complement to physical transportation infrastructure. The quality of communication infrastructure services is not only strongly correlated with search costs, but also with costs of entering into contracts

with suppliers and monitoring implementation of those contracts. Costs related to the time elapsed between the perception of demand and subsequent supply of products to the relevant retailer(s) can also figure prominently (Nordas and Piermartini 2004).

Fink, Matus, and Neagu (2002) find that the cost of making a telephone call has a significant and negative impact on bilateral trade flows. In addition, the bilateral costs of telecommunications have a greater effect on trade of differentiated products than on trade of homogeneous products. This reflects the value of access to information and the importance of information technology infrastructure, as well as telecommunications, at the dynamic extensive margin of trade. In particular, as the number of smaller shipments of a wider variety of higher value added products rises, demand for ICT infrastructure services also rises.

Telecommunications infrastructure is also especially important for trade in services, where the main services traded (banking and business services, communications, etc.) are highly dependent on well-developed infrastructure both in the exporting and importing countries and linking the two (Nicoletti, Golub, Hajkova, Mirza, and Yoo 2003). Given the huge value of ICT infrastructure demanded, it is fortunate that ICT is an infrastructure sector that the private sector is especially adept at innovating, expanding, and financing due to its pricing and cost-recovery characteristics, while the need for mutually interfacing logistics services at both ends of the trade route points to an area for regional cooperation to capitalize on externalities in enhancing trade.

VIII. CONCLUSIONS

Over the next few decades, developing Asian economies are likely to make up the lion's share of the fastest growing markets in the world. An important part of this growth will come through trade expansion, regional integration through the fragmentation of production networks across national borders, and the broadening and deepening of international capital flows to support trade and production expansion. Already, close to a quarter of world trade takes place between countries sharing a common border and half of world trade occurs between partners less than 3,000 kilometers apart (Berthelon and Freund 2004).

The impacts of trade-related infrastructure are being leveraged by coordination across borders. Supported by a conducive policy environment and capitalizing on regional externalities through cooperative arrangements, the expansion, improvement, and maintenance of infrastructure services can reduce trade costs and facilitate trade expansion, economic growth and development, and regional integration.

The demand for information and related services (such as finance and telecommunications) can be expected to grow faster than the demand for transportation of goods and people. The telecommunications and internet revolution has restimulated international integration, resulting in growing trade in information and ICT, in outsourcing services, and in migration of highly skilled labor. Similarly, as the density of economic activity increases with population and income growth, and modern flexible manufacturing practices spread, moving production closer to consumers, there may be an increasing demand for short-haul relative to long-haul transportation, at least in the domestic context.

Efforts to expand and enhance infrastructure services will reduce costs of doing business, of achieving economies of scale, and of international trade, helping to maximize growth and the benefits of regional trade and investment integration. At the same time, infrastructure improvements, complemented by trade expansion, will attract and facilitate greater investment in productive capacity, expand access to markets and employment opportunities for the poor, and broaden the range of consumer choice for Asia's billions.

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