

Transport Costs and Specialization



The sharpest insights sometimes come from piecing together bits of information that separately can be innocuous and unsurprising. In the mid-1970s overseas transport costs had fallen to a fraction of what they were in 1900, thanks to such inventions as steam power and the telegraph. And the share of trade between neighboring countries in Europe had risen relative to their trade with countries more distant. In 1910 British exports were spread quite evenly between Europe (35 percent), Asia (24 percent), and other regions (31 percent). By 1996, 60 percent of Britain's exports went to Europe and only 11 percent to Asia.¹

Singly, neither fact is surprising. Together, they are exactly the opposite of what standard economics would predict. After all, transport costs should be a larger part of the cost of goods shipped from half a world away than for goods traded with neighbors. So a fall in transport costs should have meant *more* trade with distant partners than with neighbors, not less. What had happened?

Research in the 1980s provides the answer.² Two waves of globalization—a euphemism for falling transport and trade costs—were responsible. During the first wave from about 1840 to World War I, transport costs fell enough to make large-scale trade possible between places based on their comparative advantage. So Britain traded machinery for Indian tea, Argentine beef, and Australian wool; trade increased between distant and dissimilar countries. During the second wave after 1950,

transport costs fell low enough that small differences in products and tastes fueled trade between similar countries, at least in Europe and North America. Neighbors traded different types of beer and different parts of cars, such as wheels and tires. Trade in parts and components grew to take advantage of specialization and economies of scale. The first wave of globalization was characterized by “conventional,” inter-industry trade that exploited differences in natural endowments, the second by a “new international trade” driven by economies of scale and product differentiation.

Transport costs and scale economies interact to produce the trade flows observed in the past half-century.³ The main insight from research is that the relationships between transport costs, production locations, and trade patterns are nonlinear. Falling transport costs first led to countries trading more with countries that were distant but dissimilar. When they fell further, they led to more trade with neighboring countries. Similarly, when transport costs fell from moderate levels, production concentrated in and around large markets.

In East Asia, as the costs of transporting goods by sea and air fell, the production of manufactured goods spread from Japan to neighboring economies such as Hong Kong, China; the Republic of Korea; and Taiwan, China. Production then moved to Southeast Asia, and now it has moved to China. With a fall in telecommunication costs, large cities in the United States and Europe reaped the rewards of growing markets. But as the costs of telecommunications fell

further, services such as accounting and call centers moved to smaller cities in Europe and North America, and then, as they fell further, to cities in distant India and the Philippines.

Intraindustry trade—the exchange of broadly similar goods and services—is perhaps the most important economic development since World War II. Countries trade Samsung, Motorola, and Nokia phones; casings for television remotes; and buttons and stitching for textiles. Such trade is now more than half of global trade, up from a quarter in 1962. The share of intraindustry trade has gone up for all types of goods and services, from such primary goods as oil and natural gas, to such intermediate inputs as auto parts and computer help-lines, to such final goods as food and beverages (see figure 6.1, panel a).

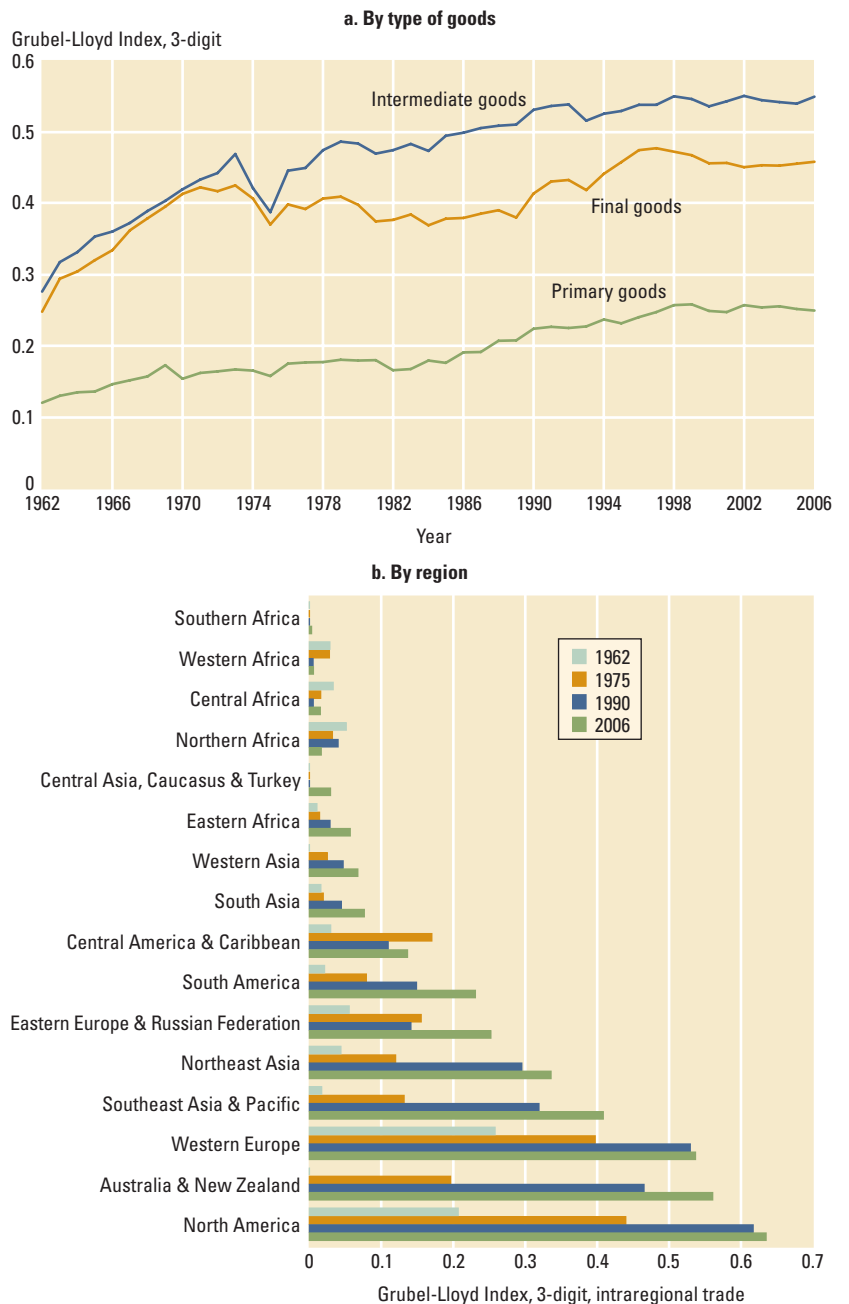
This is important because of the border-related divisions identified in chapter 3. These divisions are barriers to movements of capital and labor. If all that countries could trade were final goods, such as televisions and cars, then convergence in living standards would be slow at best. With trade in intermediate inputs, the potential for specialization and trade increases significantly. The efficiencies generated through specialization and scale economies in production and transportation have indeed benefited the world. But these benefits have not been shared evenly (see figure 6.1, panel b). East Asia, North America, and Western Europe account for much of the world’s intraindustry trade.

This chapter explains why these regions account for this trade and what this means for developing countries. In good measure the reasons have to do with the interactions between scale economies and transport costs. Transport and trade costs influence trade volumes. A 10-percent increase in trade costs is estimated to reduce trade volumes by 20 percent.⁴ Trade in intermediate goods is especially sensitive to transport costs. If the share of imported intermediate inputs in final demand is large, small changes in transport costs can have large effects on the volume of trade flows—the “trade friction” increases. For instance, a 5-percent increase in transport costs can produce trade friction equivalent to an ad valorem tax of almost

50 percent, when the share of intermediate inputs in value added is 70 percent.⁵ As transport costs fall, then, trade in intermediates would also increase rapidly.

“Circular causation” also affects transport. Trade volumes influence transport costs. On the trans-Pacific route, cost differences between a “Panamax” unit of 4,000

Figure 6.1 Intraindustry trade is becoming more important for all types of goods, but not in all world regions
Evolution of global intraindustry trade, by 3-digit product group, 1962–2006



Source: Brühlhart 2008, for this Report.
Note: The Grubel-Lloyd Index is the fraction of total trade that is accounted for by intraindustry trade.

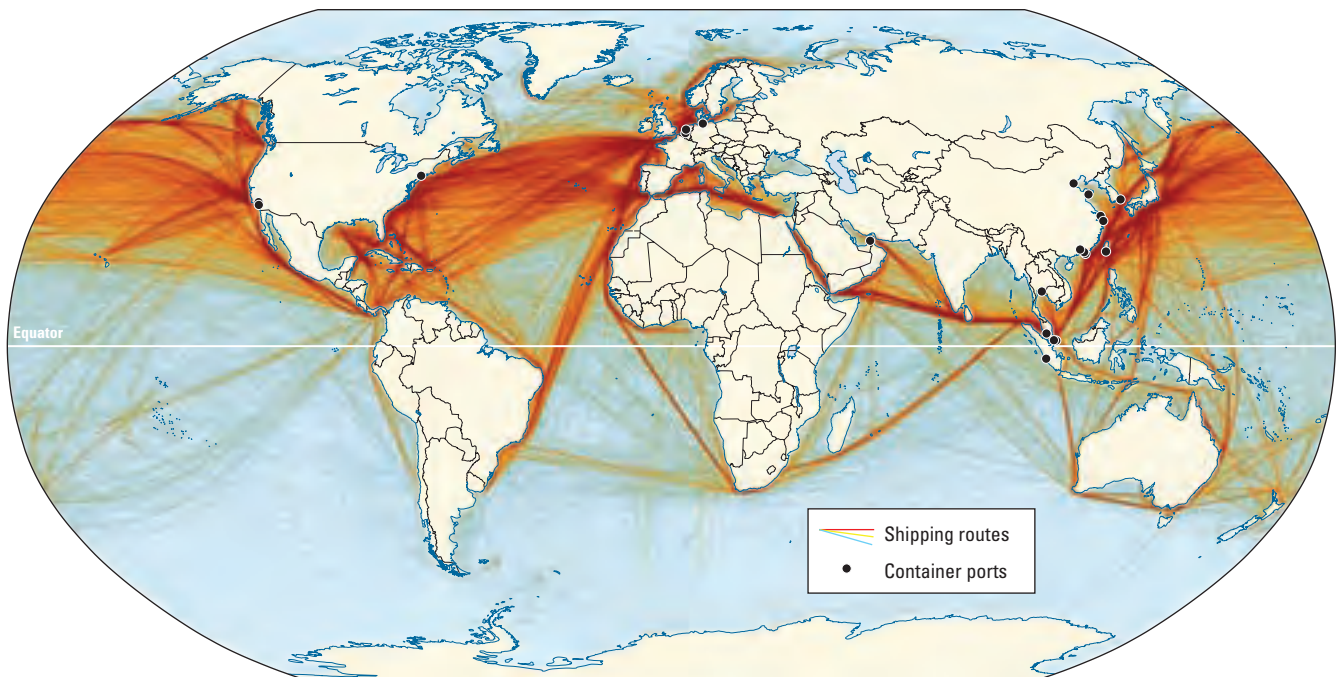
TEU (20-foot equivalent units, a measure of shipping tonnage) and a mega post-Panamax unit of 10,000 TEU are 50 percent. But exploiting these cost advantages requires large trade volumes and high capacity, because economies of scale are available not just in the production of goods and services but also in their transport. It costs about \$400 to ship a container to the United States from China, about \$800 to ship from India, and \$1,300 to ship from Sierra Leone.⁶ China's enormous trade is almost certainly a reason for low transport costs, just as falling transport costs have encouraged countries to move production to China. Scale economies in transport mean that falling transport costs and increasing trade reinforce one another.

The Northern Hemisphere is heavily trafficked, with ever-strengthening trade links as intraindustry trade flourishes (see map 6.1). But ships sail through or around Central America, South Asia, and Sub-Saharan Africa, going only to countries that have natural resources such as oil. Trade passages between South America and the most prosperous parts of the world are narrow roads, not the busy expressways between East Asia, North America,

and Western Europe. Global air and Internet traffic maps show a similar imbalance. These developments should be disconcerting for developing countries not integrated into these self-reinforcing production and trade networks. Scale economies in production and transport will make it more difficult, not easier, for developing countries to enter these highly competitive markets.

A world of nonlinear relationships and cumulative causation is a world with thresholds. Knowing how developing countries can get past these thresholds depends on where they are, what they produce, and the costs that traders must pay. In the developed world, the total trade and transport costs as a share of the value of goods can be split into 20 percent transport costs, 45 percent border-related trade costs, and 55 percent retail and wholesale distribution costs. These costs multiply, piling up to a 170 percent tax on the value of goods and services traded.⁷ What they show is that lower international transport costs have reduced distance but that trade costs due to *international division* remain high. Meanwhile, transport costs due to *internal distance* have stayed high even in the developed world.

Map 6.1 Busy seafaring in the North, little landfall in the South
Intensity of shipping routes during one year beginning October 2004



Sources: Data from the World Meteorological Organization (WMO) Voluntary Observing Ships' (VOS) scheme, processed by Halpern and others 2008.
Note: Container ports shown are the 20 largest by TEU of total containers handled in 2005 (Heideloff and Zachial 2006).

Developing countries can learn how countries have reduced transportation costs, including how trade has been stimulated and new technologies developed. From the analysis of the past two decades, they can learn how spatial concentration of production may change as transport costs fall. What does this mean for latecomers to economic development? The main points:

- ***Better transport technologies developed over the past two centuries have increased the volume of trade and radically altered its nature.*** Before World War I transport costs declined enough to make large-scale trade possible, but only between countries that were dissimilar. They happened to be countries that were distant, because big differences in climate and natural endowments usually meant the countries were in different parts of the world (Indonesia and the Netherlands, for example). During the second wave following World War II, transport costs fell enough for small differences in products and tastes to fuel trade. This led to a rise in trade between countries that are similar (for instance, Argentina and Brazil), which often happen to be neighbors.⁸ As transport costs fall, physical geography matters less. But with economies of scale in production, economic geography matters more.
- ***A decline in transport costs—with increasing returns to scale—generally means more spatial concentration of production.*** Recent thinking in economics has emphasized the importance of transport costs in development. With high transport costs, large economies of scale will remain unexploited, and production inefficient. Efficient production is more specialized. When transport costs fall, spatial differences in production and economic growth will increase, both within and between countries.
- ***Developing countries should pay more attention to transport and communications regulations to reduce transport and trade costs.*** The new economic geography has inadvertently contributed to an exclusive policy focus on “hard” infrastructure. The most critical policy-

related aspects—the naturally monopolistic nature of transport—have been assumed away. Developing countries should do more to address the negative effects of market structure in the transport sector. And for some aspects of the agenda, they will need international support.

What has happened: two centuries of experience

Falling transport costs in the 100 years or so before World War II brought closer economic integration within and between countries. Then, as in the twentieth century, the fall was caused by large infrastructure investments and breakthroughs in transport technology.

From the early nineteenth century to the beginning of World War I, the global economy went through what economic historians call the “first era of globalization.” Domestically, canals and then railways greatly reduced transport costs, leading to larger integrated home markets and to converging prices for manufactured and agricultural goods. The routing of these transport links greatly influenced the rise and decline of urban agglomerations. Internationally, steamships lowered maritime transport costs and increased the speed and reliability of service. The results were narrower intercountry price differences, expanding trade on routes that the new shipping technology could serve, and the emergence of large-scale interindustry trade.

Domestic transport. Inland waterways and railways reduced intercity and interarea transport costs dramatically in the first half of the nineteenth century. Before the railway era, which started around 1830 in Europe, most transportation was on roads or—50 to 75 percent cheaper—on water. In the United States massive investment in canal construction completely changed interregional trade and shaped a new urbanization pattern. The construction of the Erie Canal between 1817 and 1825 reduced the cost of transport between Buffalo and New York City by 85 percent, cutting the journey time from 21 days to 8. Productivity in the U.S. internal transportation sector grew at an annual average

of 4.7 percent in the four decades before the Civil War. British navigable waterways quadrupled between 1780 and 1820. French canal construction boomed similarly, and continental European countries made a big step toward overcoming division when the Congress of Vienna recognized the freedom of navigation on the Rhine in 1815. Steamships appeared on important rivers and lakes in the early nineteenth century, drastically reducing travel times.

The major nineteenth-century development in transport was the expansion of railroads, which quickly surpassed inland waterways and “performed the Smithian function of widening the market.”⁹ Cities no longer just provided public services—they attracted industries with increasing returns to scale, reaping productivity effects from the more specialized inputs and larger labor markets. In the United States the expansion of the railways had strong effects on the geographic distribution of economic activity. Illinois, Michigan, and Ohio had marked increases in population, construction, and manufacturing with the new rail lines within and across their borders. One canal after another was abandoned. In 1850 boats carried six times the freight of railroads; by 1890 railroads carried five times the freight of boats. The drop in transport costs narrowed price differences for agricultural goods between local markets dramatically. The spread in the wheat price between New York City and Iowa fell from 69 percent to 19 percent from 1870 to 1910, and between New York City and Wisconsin from 52 percent to 10 percent.¹⁰

Railways expanded less in Europe than in the United States, reflecting the national scope of rail systems and the smaller size of European countries.¹¹ The higher freight transport intensity of U.S. rail propelled a further productivity increase. In 1910 the labor productivity in American railways was 3.3 times that in Britain, a gap that had doubled since 1870.¹² Russian railway construction took off after the mid-1860s, spreading wheat and rye production with the narrowing of regional price differences. The export share of Russian agriculture increased from 29 percent of the grain produced in European Russia to more than 42 percent between 1906 and 1910.¹³

India’s rail expansion had even bigger impacts. In the 1860s the prices in some districts were 8 to 10 times higher than in others, and famines were common. The rail system reduced transport costs by about 80 percent, and the coefficient of variation of wheat and rice prices fell from more than 40 percent in 1870 to below 20 percent in the decade before World War I.¹⁴ Lower transport costs had little effect on industrial development, however. At the turn of the eighteenth century, modern industry employed 2 to 3 percent of India’s industrial workers (about 10 percent of the workforce). Modern factories were concentrated in two maritime trading hubs, Bombay and Bengal.¹⁵

International transport. The investments in domestic transport created large and integrated home markets. Tariff barriers remained low, and international trade benefited from technical and organizational progress, mostly in shipping. Ocean shipping rates differed substantially for routes and commodities, reflecting cost differences in harbor technologies, ship types, and stowage opportunities.¹⁶ But overall the trade costs for grain, the main internationally traded good, fell by 40 percent between 1880 and 1914 within Europe and between the United States and Europe. This substantially reduced the price differences between exporting and importing countries.

Liverpool wheat prices exceeded Chicago prices by 58 percent in 1870, 18 percent in 1895, and 16 percent in 1913.¹⁷ For nonagricultural products, the reduction in price differences was no less impressive. The Boston-Manchester cotton textile price gap fell from 14 percent in 1870 to –4 percent in 1913, while the pig iron price gap between Philadelphia and London fell from 85 percent to 19 percent.¹⁸ International prices also converged in European trade. The steamboat initially shifted the relative importance of trade relations from European and Asian routes to the North Atlantic routes. Steamships could not serve Asia until the opening of the Suez Canal because coal was not available on the long route around Africa.¹⁹

During this first era of globalization, increasing competition from abroad due to

declining transport costs gave rise to protectionist trade policies. In North America, during the Civil War, tariffs reduced the financial burden on the federal government, and they remained high after the war ended. Continental Europe shifted away from liberal trade policies in the late 1870s in response to cheap American and Russian grain. Tariffs were reintroduced on finished manufactured and agricultural goods.

Increasing “transport intensity” and intraindustry trade in the modern era

Freight costs have about halved since the mid-1970s,²⁰ driven by investments in transport infrastructure, better capacity use, and technological progress. Recent trends differed from those in the first era of globalization:²¹

- The major cost declines have been in road and air transport. Maritime transport went through the containerization revolution without reducing costs overall.
- The surge in international trade has been within industries, not between them, as in the first episode of falling trade costs.
- Reduced trade friction has been less a consequence of falling transport costs than of a drop in freight costs as a share of the value of goods traded. Most of the increase in trade has been in easily substitutable goods.²²
- Transport reforms and falling trade barriers have contributed substantially to the fall in transport costs.
- Falling communication costs, interacting with falling transport costs, have been instrumental in fragmenting production processes and outsourcing intermediate goods production. Relative wage differences have become more important because of the lower costs of managing production processes over long distances.

Road transport costs. Road transport costs have fallen substantially, by almost 40 percent over the past three decades, despite higher energy and wage costs. (Comprehensive statistics on prices for transport services do not exist, and the implementation of price indexes as part of the system of national accounts is still in its infancy.

Empirical assessment therefore depends on the estimation of transport costs.) One study in France shows that truck transport costs fell by 33 percent between 1978 and 1998,²³ with substantial regional variation due to the differences in the quality of roads and the charges for road use. The main contributors were the deregulation of the trucking industry (a reduction of 21.8 percentage points) and the lower vehicle costs (−10.9 percentage points). Transport infrastructure (−3.2 percentage points) and declining fuel costs (−2.8 percentage points) were much less important.

Rail freight costs. Rail costs fell much less than road costs. Technical progress was uneven across rail submarkets, and the monopoly power of large, mostly state-owned enterprises slowed cost reductions (see box 6.1). Obligations to serve regions with small transport, for instance, have

BOX 6.1 *Biggest in the world: size and social obligations of Indian Railways*

The railway industry exhibits increasing returns to scale in two ways. First, network economies and economies of density lead to size advantages at the firm level. Second, rail transport operations are almost universally combined with the supply of infrastructure services, granting rail firms a natural monopoly, at least locally. Given the importance of the railways for economic development and the enormous market power of rail firms, it is not surprising that many rail companies are state owned.

The biggest of these mammoths is Indian Railways. The *Guinness Book of World Records* lists it as the world’s largest commercial or utility employer, with more than 1.6 million employees. It moves more than 16 million passengers and more than 1 million tons of freight each day. In 2002 it ran 14,444 trains daily, 8,702 of them for passengers, and owned 216,717 wagons, 39,263 coaches, and 7,739 locomotives.

Founded in 1853 as a system of 42 rail systems, it was nationalized as one unit in 1951. Vertical integration of Indian Railways is not confined

to the bundling with infrastructure services. It owns and runs factories for locomotives, coaches, and even their parts. Long transport distances on the Indian subcontinent should give the railways a stronger competitive edge over roads. Indeed, Indian Railways makes 70 percent of its revenues and most of its profits from freight, cross-subsidizing the loss-making passenger sector. The overpricing of freight services is one reason it has lost business to roads in recent years.

Curtailling the potential to provide low-cost freight transport over long distances are extensive social obligations. Net social service obligations in 2005–06 were more than Rs 47 billion, plus welfare costs of Rs 9.6 billion. The service obligations include shipping essential commodities (sugar cane, livestock, paper) below cost, having freight subsidize passenger and other coaching services, and opening new unprofitable lines. A major part of the passenger transport deficits covered by freight are urban and suburban losses in Chennai, Kolkata, and Mumbai.

Source: WDR 2009 team.

motivated demands for public subsidies and cross-subsidies from profitable routes.

Rail costs are specific to the commodity shipped. For the United States, this has been shown to depend on price discrimination by the freight railroads among shippers of different commodities.²⁴ There was no uniform development of rail freight rates from 1981 to 2004. Markups for coal and grain have increased significantly. Markups in intermodal traffic have been lower because of competition from trucking and rail-to-rail competition between major cities. Decreasing or flat rates had been observed for shipping chemical products and automobiles. This mainly indicates the high value of these goods. Freight demand is a derived demand, and the prices shippers are willing to pay increase with the value of the shipments.

Air transport costs. With the arrival of the jet engine, air transport costs came down quickly from the mid-1950s to the early 1970s. Jet engines were faster, more reliable, and more fuel efficient than the piston engines they replaced (see box 6.2). Quality-adjusted real prices of aircraft fell by 13 to 17 percent annually from 1957 to 1972.²⁵ Technical progress slowed considerably after 1972, but prices were still falling by 2 to 4 percent a year from 1972 to 1983.

Between 1955 and 2004, air freight prices fell from \$3.87 per ton-kilometer to less than \$0.30, in 2000 U.S. dollars. Average revenue per ton-kilometer fell 8.1 percent a year in 1955–72 and 3.5 percent a year in 1972–2003. Despite this significant decline in nominal air freight rates, the trade friction in air transport did not fall as dramatically. The price of air shipping in real U.S. dollars per kilogram increased 2.9 percent annually from 1973 to 1980, in part due to oil price increases, and then declined by 2.5 percent annually from 1980 to 1993. The post-1980 decline varied substantially among routes, with longer routes and North America showing the largest drops.²⁶ After 2001 the real price of inbound air freight to the United States rose sharply, possibly reflecting higher security costs.

Maritime transport costs. Two submarkets have developed differently over the past decades. Tramp shipping is used for large

quantities of bulk commodities on charter, with shipping prices set in spot markets. There are no fixed schedules or routes, so shipping is determined by current market demand. Liner shipping is used for general cargo on fixed trade routes and on a fixed timetable. The liner trade is organized into cartels, or conferences, which discuss and coordinate prices and market shares.

Technical progress and institutional changes have reduced prices in both submarkets. The most important are the growth of open registry shipping, the scale effects from the enormous increase in maritime transport demand, the introduction of containers, and the resulting changes in port logistics. Open registry shipping is the practice of registering ships under flags of convenience (Liberia and Panama) to circumvent higher regulatory and manning costs imposed by wealthier nations. Open registry fleets did 5 percent of world shipping tonnage in 1950, 31 percent in 1980, and 48 percent in 2000.²⁷ It is estimated that vessel expenses for open registry ships are 12 to 27 percent lower than those of traditional registry fleets, with most of the cost differences coming from labor costs.²⁸

Cost reductions because of scale effects come from greater vessel capacity and institutional changes. The rapid expansion of maritime transport demand seems to have accommodated these changes and reduced the danger of preemptive competition.²⁹ The increase in vessel size seems to have allowed for hub-and-spoke economies—smaller vessels move cargo to a hub, where shipments are aggregated into much larger and faster ships for longer hauls. Prime examples are Hong Kong, China; Rotterdam; and Singapore.

Vessels for bulk commodities, refrigerated produce, and automobiles are profitable on individual routes. Since the mid-1980s, dedicated “juice tankers” have cemented Brazil’s dominant position in the global export market for orange juice, almost all produced in São Paulo State. Standardized containers provide cost savings across transport modes—long-distance truck, inland waterways, rail, and short-distance truck—because goods do not need to be

BOX 6.2 *The jet engine*

An estimated 320 million people meet annually at professional and corporate events after traveling by air. Of the world's \$12 trillion of merchandise trade, 35 percent by value was shipped by air in 2006.^a The estimated economic rate of return from investments in aviation infrastructure and services is 56 percent in Kenya, 28 percent in Jordan, and 19 percent in Cambodia.^b The reason for all this is the jet engine, perhaps the most significant innovation in long-distance transport ever. The jet is safer, easier to maintain, better suited for longer distances, and more fuel efficient than the propeller. Since it revolutionized air travel in the 1960s, it has become so closely identified with aircraft propulsion that one wonders how the aircraft industry managed to make so much progress with pistons.

But as with many path-breaking inventions in transport technology, the gestation period between invention and economic success was long. Frank Whittle in Great Britain, in 1929, and Hans von Ohain, a German physicist, in 1933, independently developed concepts for jet propulsion. Jet engine technology progressed quickly after World War II. The breakthrough in commercial passenger travel arrived with the Boeing 707 and Douglas DC-8. Earlier jet aircraft were noisy and had higher operating costs than advanced piston-engine aircraft. They could compete only on speed and greater seat capacity. But in the early 1960s, technology improvements (the so-called by-pass engine) rang in the end of propeller-powered long-distance travel. Within five years, prices per ton-kilometer fell by about 40 percent.

Jet aircraft have a much higher power-to-weight ratio, which enables longer range, faster travel, and bigger payloads. Higher quality and lower cost had a large impact in many sectors.

- *Supporting buyer-supplier networks over long distances.* Most global trade is by

maritime shipping, but air transport fills an important niche in just-in-time production systems. While shipments by sea are routine, firms use air cargo to fine-tune intermediate input flows and to ship goods with high value-to-weight ratios. Even for Brazil, known for its primary goods exports, air cargo in 2000 accounted for 0.2 percent of total export volume by weight, but almost 19 percent by value.^c Incidentally, Brazil is also home to the world's third-largest airplane maker, Embraer. Prime examples of sectors benefiting from air transport are semiconductors and fashion. Shipments of semiconductors are so highly correlated with air freight overall that they are considered a key leading indicator for the sector's health. Product cycles in the fashion industry have shortened so much that one Spanish clothing chain ships merchandise straight from factory to store, replacing designs twice a week. The need to respond quickly to changing customer tastes has led to the relocation of some of its production from East Asia to Spain and nearer countries like Morocco and Turkey. From there, clothes are sent to stores elsewhere in the world: "Planes from Zaragoza, Spain, land in Bahrain with goods for Inditex stores in the Middle East, fly on to Asia, and return to Spain with raw materials and half-finished clothes."^d

- *Enabling exports of perishable goods over long distances.* Inexpensive and frequent air service has allowed countries like Chile, Colombia, and Kenya to sell agricultural and horticultural products to markets in Europe, the Middle East, and North America. A prime example is Kenya, which today has a third of the global market for cut flowers. Naivasha in central Kenya hosts a highly efficient cluster of growers, showing that localization economies also exist in agriculture. Flowers picked

in the morning arrive on Amsterdam's markets by evening. Horticulture is now among the top three export earners (with tourism and tea). In 2007 the sector's free on-board (FOB) export value was 43 billion Kenyan shillings (about US\$650 million), and the Kenya Flower Council estimates that the livelihood of 1.2 million people depends directly or indirectly on the industry. By contrast, Bangladesh's lack of cold storage facilities and refrigerated air cargo capacity has blunted its opportunities to export high-value fruits and vegetables to the Middle East.^e

- *Mass tourism in developing countries.* In 2005 tourism receipts in low- and middle-income countries were about \$200 billion,^f thanks mostly to inexpensive air travel. Charter flights provide even larger cost reductions through packaging with other services and high-capacity use. Airport construction in tourist areas generates clusters of development with a high density of complementary services and thick and specialized labor markets. Between 1990 and 2005, tourist arrivals in Sub-Saharan Africa increased by 8 percent a year—from 6.8 million to 23.6 million—and tourism receipts, from \$4.1 billion to \$14.5 billion. Tourist arrivals in China grew almost 10 percent annually. Cambodia now receives more than 2 million tourists a year, Vietnam about 4 million—16 times as many as in 1990.

Source: WDR 2009 team.

a. International Air Transport Association 2007b.

b. International Air Transport Association 2007a.

c. Sanchez and others 2003.

d. Rohwedder and Johnson 2008.

e. Dixie 2002.

f. World Tourism Organization (UNWTO) 2006.

unloaded and reloaded (see box 6.3). Containerization reduces direct port costs for storage and stevedoring. It also reduces the indirect capital costs of idle capacity during long port stops, which previously made up

half to two-thirds of a ship's lifetime.³⁰ And it allows for larger and faster ships, which reduce the costs per ton-mile while the ship is steaming. These cost reductions on the ocean leg have more than compensated for

BOX 6.3 *The big box*

About 90 percent of nonbulk cargo worldwide is transported in containers stacked on trucks, rail wagons, and freight ships. In 2007 more than 18 million containers made more than 200 million trips. Containerization has even changed how port and ship capacity or maritime transport services are measured. Cargo shipped is now measured in TEU or 40-foot equivalent units (FEU). A TEU is the measure of a box 20 feet long and 8 feet wide, with a maximum gross mass of 24 metric tons.

The revolution is popularly attributed to Malcom McLean.^a He owned a trucking firm in New Jersey and had a simple insight: packages being shipped generally need to be opened only at origin and destination, but unloading and repacking costs a lot of money. In 1956 he inaugurated the Sea-Land Service, with his converted tanker ship, the *Ideal-X*, setting sail from Newark, New Jersey, for Houston, Texas, carrying 58 aluminum truck bodies in frames installed atop its deck.

The idea did not spread widely until more than a decade later, when the U.S. armed forces needed efficient military transport to Vietnam. Against considerable resistance, McLean won contracts to build a container-port at Cam Ranh Bay and to run containerships from California to Vietnam. Without the containers, the U.S. military would have had a tough time feeding, housing, and supplying the 540,000 soldiers, sailors, marines, and air force personnel in Vietnam in 1969. From almost nothing in 1965, Sea-Land's Defense Department revenues rose to \$450 million between 1967 and 1973. Routes to Okinawa and Subic Bay in the Philippines were added later, but McLean's business remained restricted to military logistics.

The Japanese government was the first to support the expansion of containerization. In 1966 the Shipping and Shipbuilding Rationalization Council urged the Ministry of Transport to eliminate excessive competition to benefit from the new technology. It persuaded the government to build container terminals in the Tokyo-Yokohama and Osaka-Kobe areas. The first container cranes began operation in 1968. But highway regulations barred full-size containers, and the Japanese National Railway was not equipped to carry containers longer than 20 feet.

In the United States, Matson Navigation won government approval to operate an unsubsidized container service between the U.S. West Coast and Hawaii and East Asia. The company had visions of unloading cargo at Oakland directly onto special trains that would carry it east. On the return trip, the company planned to carry military cargo for the U.S. bases in Japan and the Republic of Korea. Business could not start before Matson entered a joint venture with a Japanese partner, and the containership that completed its maiden voyage in 1968 from Japan to the United States was owned by Nippon Yusen Kai-sha Line. Six weeks later, McLean's Sea-Land Services started a regular service between Yokohama and the U.S. west coast.

Once the infrastructure facilities were in place, container traffic took off. By the end of 1968 the Japan-U.S. route was crowded with containerships, seven companies competing for fewer than 7,000 tons of eastbound freight each month. The speed of expansion was determined by port and rail infrastructure. In the United States, rail intermodal traffic tripled between 1980 and 2002, from 3.1 million trailers and containers to 9.3 million.

Container transport has continued to increase at enormous rates. The boxes keep getting larger, with the standard FEU size giving way to 48-foot and 53-foot boxes that allow trucks to haul more freight on each trip. The world's fleet is expanding steadily, with the capacity of pure containerships rising by 10 percent annually between 2001 and 2005. The size of the vessels has been increasing, too. Dozens of vessels able to carry 4,000 FEU joined the fleet in 2006, and even larger ones were on order. The *Emma Maersk* (396 meters long), launched in 2006, can carry more than 14,500 TEU. Of all traffic, 26 percent now originates in China.

Geography and topography limit the ever-increasing size of ships: Because the Panama Canal lost more traffic with the old locks unable to accommodate vessels larger than 5,000 TEU, it now is being expanded to allow ships up to 12,000 TEUs to pass. Most of the container ships are too large for the Suez Canal as well. Container ships have an absolute size, limited by the depth of the Straits of Malacca, linking the Indian Ocean to the Pacific Ocean. This "Malacca-max" size constrains a ship to dimensions of 470 meters long and 60 meters wide.

And what happened to Malcom McLean's company? Sea-Land grew and was the biggest shipping company in 1995. The Danish company Maersk was second, followed by Evergreen. Four years later, Sea-Land was acquired by Maersk. By 2000 Maersk-SeaLand had a slot capacity of about 850,000 TEU. McLean's big box is here to stay.

Source: WDR 2009 team.
a. Levinson 2006.

higher investment costs and higher costs for slack time in ports.³¹

But containerization has also concentrated shipping capacity in a few global ports. Most developing countries have been slow to containerize, because of their small trade volumes and different factor prices. Where capital is scarce and labor abundant, the capital cost of specialized cranes, storage areas, and rail heads is higher, and the

port cost savings of containers are much lower.

How did this technological change affect shipping costs? When adjusted for inflation, the real price for tramp services in 2004 was about half the real price in 1960.³² But when deflated using the commodity price index, there are large fluctuations but no downward trend. This means that the trade friction resulting from transport costs for bulk

commodities typically shipped by tramp trip charters has not gone down—the price of transporting a dollar’s worth of iron ore or wheat has not fallen. Liner prices show a steady rise before peaking in 1985, based on long time-series from the German Ministry of Transport. The price index for liner shipping emphasizes general cargo, including containerized shipping and manufactured merchandise. It also covers loading and unloading expenses, which are particularly relevant because reductions in cargo handling costs are thought to be a major source of gains from containerization. Measured relative to the German GDP deflator, liner prices declined until the early 1970s, rose sharply from 1974 to reach their peak in the 1983–85 period, and declined afterward.

These trends in shipping costs run counter to public perceptions of continually falling trade costs. Two possible explanations: First, these price trends do not capture the true cost savings of containerization, since they do not factor in the total cost of door-to-door transportation. In 1956 the loading of loose cargo cost \$5.83 a ton. When containers were introduced in that year, the loading cost was less than \$0.16 a ton.³³ So the main savings came from lower intermodal transfer costs. Containerization allowed goods to be packed only once and shipped over long distances using maritime, rail, and road transport. Second, the quality of transport and logistics services increased markedly, particularly their speed and reliability. The absence of a more significant price decrease is thus explained, at least in part, by a greater willingness to pay for higher quality services.

Small declines in transport costs, but a big easing in trade friction

Cost information suggests that international transport costs have not dropped as much as is commonly believed. Real prices of air and maritime transport have not fallen or risen much since the 1970s and early 1980s. But the ad valorem transport charge—the cost of transport as a share of the value of the traded good—has gone down. Explaining the decline are changes in the composition of traded goods and the composition of trading partners.³⁴ One change is the

reduced weight-value ratio in all international transport. A second is the lower price of air transport relative to maritime transport. Goods that traditionally have been transported by sea are now shipped by air. After accounting for the changes of the weight-value ratios, the modal shift, and the changes of routes, the ad valorem tax equivalent of maritime transport fell more than that of air transport (see figure 6.2).³⁵ Changes in the composition of goods and trading partners reduced the market friction of transport, not its costs.

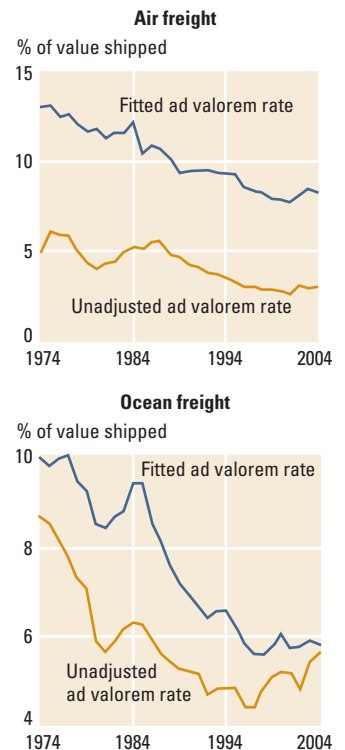
Logistics, time, and international trade.

Transport services are not a homogeneous good, and transport costs are not product- or place-neutral. The revenue figures and price indexes do not indicate quality or speed. Shipping containers from Europe to U.S. destinations still requires two or three weeks—from Europe to Asia five weeks. But air shipping requires a day or less to almost anywhere in the world. With the decline in air transport costs, the price of speed has fallen dramatically.

This matters for trade. Every day in ocean travel that a country is distant from the importer reduces the probability of sourcing manufactured goods from that country by 1 percent.³⁶ And exporting firms are willing to pay 1 percent of the value of the good per day to avoid time losses associated with maritime transport. With the recent increase in the intensity of international trade, the demand for speed has increased. Goods with the highest time sensitivity have seen the fastest increase in trade. Examples are perishable agricultural goods and those with short product cycles such as fashion articles, where consumer preferences shift, or electronics, where the latest technology earns a premium. Such cycles are important not just for Europe, North America, and Northeast Asia but also for China, India, and Southeast Asia.

Faster transport can speed the changes in the geography of trade. Production locations for textiles and electronics were initially driven by wage costs. But with short product cycles, shorter transport times may outweigh higher wage costs, leading to relocations. Some apparel production outsourced from the United States to Asia has relocated to

Figure 6.2 Air freight costs are down less than ocean freight costs



Source: Hummels 2007.
 Note: The unadjusted ad valorem rate is the ratio of freight costs to import good value. The fitted ad valorem rate is derived from a regression and controls for changes in the mix of trade partners and products.

higher wage locations in the Caribbean and Mexico.³⁷ Short product cycles, and more generally uncertain demand, are forces for agglomeration as firms need to locate near suppliers.³⁸ But with more predictable demand, faster speed might contribute to outsourcing stages of production (component production, research and development [R&D], and assembly) to other countries according to comparative advantage.

Communication costs. The cost of a three-minute phone call from New York to London fell from \$293 dollars in 1931 (in 1993 dollars) to around \$1 in 2001 for a much better connection—and to just a few cents today (see figure 6.3). The Internet and other telecommunication advances have lowered communication costs, reducing even more the trade friction for physical goods, especially intraindustry trade. But they have had an equal if not greater impact on the trade in services. Yet many tasks that require intensive communication hardly have been affected. Direct personal interaction and face-to-face contact remain an important agglomerative force, especially and paradoxically in the most communication-intensive industries.

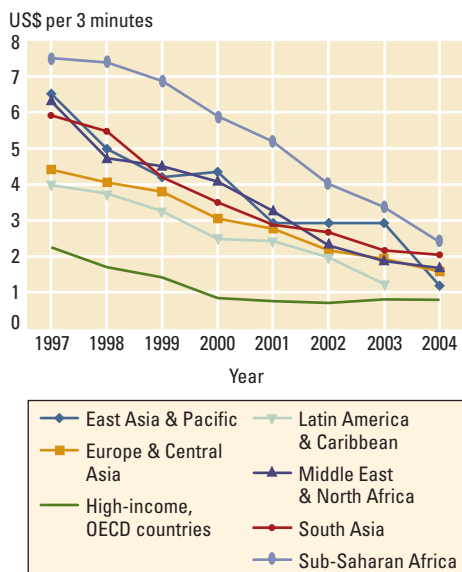
Lower communication costs facilitate the coordination of international production

networks.³⁹ But there are two more direct effects. The first is to reduce search costs. Because knowledge about potential customers or suppliers in foreign countries is imperfect, trade relations start with the search for trading partners. The search depends on the quality of the communication infrastructure, which is largely a fixed cost and therefore increases the intensity of international trade as it reduces the search cost for trading partners.⁴⁰ The second is to reduce variable trade costs. These costs arise from the need of consumers and producers to interact on product specifications, quality control, and timing.⁴¹ They are low for homogenous goods traded on organized exchanges or with reference prices. But they are high for differentiated goods.⁴² Since these kinds of goods are most prominent in trade within more disaggregated production processes, the line for communication costs played a big role in the recent surge in intraindustry trade (see figure 6.1).

Low communication costs make it possible to control production processes over long distances by computer-aided control systems and online communication, reducing the need to co-locate management and technical staff with unskilled workers. This allows vertically integrated companies to outsource production to low-wage countries. But it also facilitates the breakup of production processes into supply chains of different companies distributed across countries and continents.⁴³

Low communication costs are particularly important for offshoring tasks that do not require the shipment of physical products, such as business, professional, and technical services, including accounting, bookkeeping, computer programming, and information and data processing. U.S. imports of these services increased by more than 66 percent in real terms between 1997 and 2004. The shift of jobs to foreign countries has stirred fears among white-collar workers of massive labor market adjustments and has reduced political support for open trade regimes.⁴⁴ Contrary to these fears, business service imports in rich countries have remained fairly low. In the United States, the import share of computing and business services reached only 0.4 percent

Figure 6.3 The costs of communicating have fallen to a fraction of what they were a decade ago
Average cost of a telephone call to the United States



Source: World Bank 2007j.

in 2003, and exports of these services are even higher.

The biggest outsourcers, in relation to local value added of these services, are small countries like Angola, Mozambique, Papua New Guinea, and the Republic of Congo. Among the advanced economies, Germany, a country with high absolute imports in business services (\$39 billion in 2002), ranks 59th with a share of 2.9 percent. The United States, with the highest absolute import value in business services (\$41 billion in 2002), ranks 115th. But the United States was the biggest exporter of services (\$58 billion in 2002) and so was a substantial net exporter. Ireland shows that trade in immaterial services tends to be within industries rather than between them. It is the largest exporter of computer and information services and the fourth-largest importer. Still its ratio of exports to the local value added of computer and information services was only 16 percent (9 percent of GDP).

So the relocation of back-office services to foreign countries is not a large threat to employment in advanced countries. Trade balances in business services in almost all developed countries have been positive and increasing from 1981 to 2001. India, seen to attract many business services from rich countries, had a smaller increase in output in this sector from 1995 to 2001 than did the United Kingdom.⁴⁵ In short, the impression that services drive economic dispersion across countries is not confirmed by the evidence. Trade in these services has increased a lot, but for both imports and exports. For most countries, the share in local services remains small. And when business has been outsourced, much of it has remained concentrated in a few places. Low communication costs have had little effect on creative activities and high-value services that require frequent personal interaction.

Transport costs and scale economies: two decades of analysis

The evolution of transport costs, a critical factor in economic geography, helps explain the experience in the previous section. A fall in transport costs increases the concentration of people and firms because

it allows more efficient sharing of facilities and services. Recent research also explains two somewhat unexpected consequences of falling transport costs: (1) at the international level, trade increases with nearby countries, not with those farther away, and (2) within countries, improving transport infrastructure may lead to more concentration of economic activity, not less.

Research has been far less successful in showing why falling transport costs may make it more difficult for developing countries and lagging regions to break into world trade—indeed, increasing returns in the transport sector have often been ignored in formal models. But just as falling transport costs facilitate economies of scale in production, higher production and trade produce economies of scale in transport.

Falling transport costs create bumpy economic landscapes

Before the recent accelerated drop in transport costs, natural or “first-nature” geographic conditions (such as waterways) largely determined the location of settlements and the spatial arrangement of production and trade. Shared investments then created increasing returns to scale that shaped economic geography. Such investments could include local health and education facilities or markets and other services that reduce trade and transaction costs—such as enforcing property rights, resolving contract disputes, or identifying market opportunities. The more the people who use a facility or communal service, the lower the costs per user. The larger the settlement, the more the people who share the fixed costs. To use the service, people and goods have to travel. So as transport costs fall, access increases, scale increases and the unit cost of provision drops. This is how transport costs define the geographic size of markets and the reach and scale of communal services.

As more facilities and services are provided centrally in larger cities, smaller communities become less attractive and spatial disparities emerge—the size distribution of towns and cities changes. First-nature geography and the lumpiness of urban infrastructure investments result in irreversible dynamics that determine how the

economic landscape first becomes rough, then bumpy.

Economic historians had long recognized that these processes, driven by changing transport costs, are critical for economic development.⁴⁶ And geographers and planners formalized the effect of indivisible communal facilities in differentiating city functions and sizes in the “central place theory.”⁴⁷ Economists went beyond first-nature geography and public goods. They realized that increasing returns to scale in the production of manufactured goods and ideas further influence the distribution of economic activities in geographic space. With urbanization, manufacturing and allied services become the drivers of growth, as discussed in chapter 4. These forces interact with transport costs to determine the spatial evolution of economies, at all spatial scales—international, national, and local.

Falling transport costs increase trade between neighbors

The growing demand for varieties of similar goods helps explain the paradox that falling transport costs have led to more trade between countries that are close by and have similar characteristics. In fact, over the past 40 years, distance has become a larger deterrent to trade while divisions—border effects—have become less of a deterrent (see figure 6.4).

Traditional trade theory did not consider the increasing returns to scale and the differentiation of demand. It predicted more intensive trade in goods that are different,

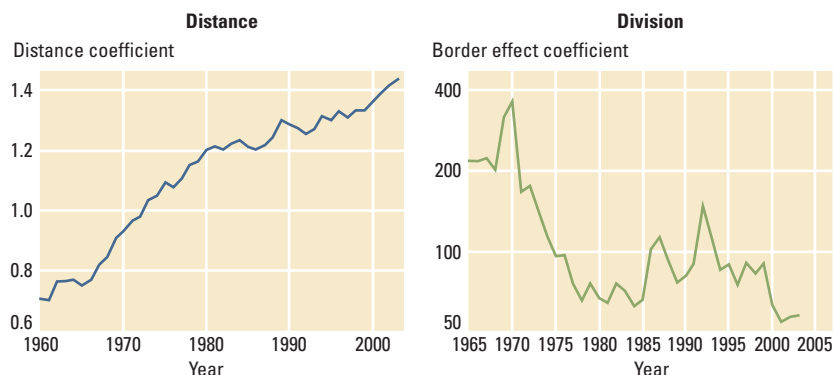
favoring trade between countries with different endowments. Countries traded because they could not produce the imported products themselves—bananas from Central America to Europe for cars in return. But with differentiated goods, trade is within classes of goods rather than between them. Countries trade because they want slightly different versions of similar goods—Japan and Sweden trade Toyotas for Volvos. In other words, in the old trade theory and with high transport costs, countries trade only what they *need to*. In the new trade theory and with scale economies, a love of variety, and low transport costs, countries trade because they *want to*.

International trade surged between (often nearby) countries of the Northern Hemisphere in the 1960s and 1970s, even though these countries have essentially similar resource endowments. Trade between rich and poor countries was initially dwarfed by these developments. In the beginning of the 1980s intraindustry trade between medium- and high-income countries expanded—and later between other categories of countries (see figure 6.5). The differentiation of demand—that is, the love of variety—and intraindustry trade did not remain confined to rich countries.

Accompanying the surge in intraindustry trade was a large increase in trade in intermediate goods relative to final goods. Intraindustry trade in intermediate goods requires an especially efficient transport sector. The ability to coordinate and control production processes in real time by computerized systems has been central to the vertical disintegration of production processes in the high-income countries and the outsourcing to medium-income countries.⁴⁸ So lower transport costs, changes in goods traded, and lower communication costs reinforce each other.

One might expect that goods with low value-to-weight ratios would be traded mainly over short distances. But product cycles for knowledge-intensive intraindustry goods and for consumer items such as electronic gadgets and fashion articles have become shorter. This greater time sensitivity helps explain why the distance-dependence of trade goes up rather than

Figure 6.4 Distance has become more of a deterrent, divisions less
Coefficients for distance and national borders in trade models, 1960–2005



Source: Mayer 2008 for this Report.

down. If countries want to benefit from current trends of globalization, regional coordination of infrastructure investment and transport policies becomes even more important.⁴⁹

How do increasing returns to scale in production, the love of variety for consumer and intermediate inputs, and lower transport costs drive concentrations of economic activities in geographic space? First, differentiated products and increasing returns to scale will increase productivity more in larger areas or countries than in smaller ones, even if they have identical per capita resources and access to the same technology. The important dimension of size is the volume of overall demand or economic mass, not the size of the land area. When such agglomeration forces are considered, both Hong Kong, China, and Singapore are viewed as “large.”

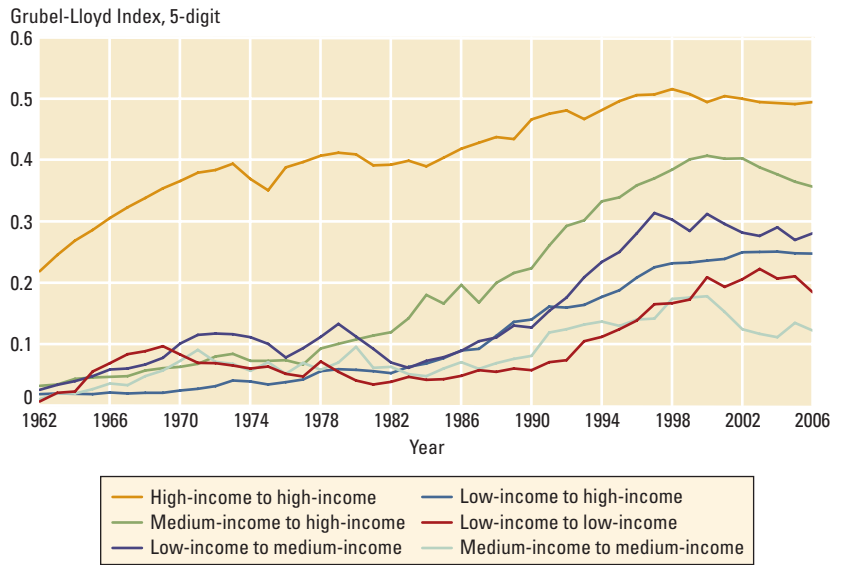
Second, the larger a region, the more varieties or intermediates will be produced locally. Compared with smaller regions, fewer goods have to be imported, saving on transport costs. People with equal nominal incomes thus have a higher real income in the larger regions, and firms realize cost savings.

Third, the higher real incomes will lead to in-migration, putting pressure on local wages. Lower wages will attract more firms, making the larger market even larger and leading to a new round of circular causation of firm relocation, higher real incomes, and a larger market. Chapter 9 discusses in more detail how developing countries can address the challenging task of regional integration, learning from the experiences with institutional cooperation, regional infrastructure, and coordinated incentives around the world.

Falling transport costs lead to concentration within countries

The productivity and income benefits of agglomeration, driven largely by lower transport costs, are often difficult for planners and policy makers to accept. But they explain the second counterintuitive implication of falling transport costs. There is a strong belief that an equal distribution of transport infrastructure will induce an

Figure 6.5 Global intraindustry trade is no longer confined to rich countries



Source: Brühlhart 2008 for this Report.
 Note: The Grubel-Lloyd index is the fraction of total trade that is accounted for by intraindustry trade.

equal geographic distribution of economic activities. High concentration is seen as a problem, and the spatial redistribution of economic mass is expected to promote overall development. Massive transport infrastructure investments have been the central policy instrument to induce firms to move to lagging regions. But the outcomes were usually the opposite—the target regions lost production and workers to the leading regions (see box 6.4).

Knowledge-sharing is another force shaping the economic geography of countries and areas. Technical know-how can be used by more users at no or small extra cost. It is embedded in an experienced workforce, and the accumulated stock of knowledge leads to innovation. Larger local labor markets increase knowledge spillovers between workers and thus increase productivity nonlinearly.⁵⁰ In big cities the benefits may not fully materialize because congestion and fragmentation hinder interaction. But well-functioning urban transport systems can increase the effectiveness of the labor market and spread the results of learning on the job (see box 6.5).

Falling transport costs enhance localization economies in the production of knowledge and information—say, for business,

BOX 6.4 *Italy's intervento straordinario: an unexpected response to falling transport costs*

Regional disparities are caused by the unequal distribution of infrastructure, and infrastructure investment in lagging areas will reduce these imbalances. That is the common assumption. But, frequently, the industries intended to prosper from these investments move elsewhere, accompanied by a mass outmigration of workers. A prime example is the Italian regional policy to reduce the development differences between the North and the South. The *Mezzogiorno* has become a generic term for a region that suffered from the good intentions of regional policy.^a

A short-term *intervento straordinario* was managed by a special agency, the *Cassa per il Mezzogiorno*, set up in 1950. It was supported by the International Bank for Reconstruction and Development (IBRD), led by Paul Rosenstein-Rodan, who developed the Big Push Model of economic development in the 1940s. The development impact was to come from massive infrastructure investment, with much emphasis on road building and railways. It soon became obvious that short-term success would not be achievable, leading to repeated redefinitions of the strategic directions. By the mid-1950s, the *Cassa* shifted its focus to supporting industry investment, concentrating on "nuclei" and priority areas.

The result was that through the 1950s about 2 million workers left the target regions. By the end of the 1960s, the emigration was perceived to be the main development problem, and infrastructure investment and subsidies were concen-

trated on the areas where emigration was, in fact, highest.^b From the beginning of the 1980s, when the original mandate of the *Cassa* ended, it was kept alive by 11 ministerial decrees. In 1986 the "extraordinary intervention" was refinanced up to 1993.

The total annual expenditures of the *Cassa* rose to a peak of 3,750 billion lire (US\$4.5 billion) in 1976, declining to 2,650 billion lire (US\$2.1 billion) in 1991, and collapsing afterward. The money had little effect on economic indicators in the *Mezzogiorno* (see box table).

The unemployment rate fell until the beginning of the 1970s because of the outmigration of millions of workers to Northern Italy and other countries. It then more than doubled up to the end of the 1980s, indicating a rapidly growing dependence of the South on fiscal transfers from the North.

Scandals surrounding the *Cassa per il Mezzogiorno* were disclosed as part of *tangentopoli* ("bribesville") by the efforts

of the *mani pulite* ("clean hands") of the country's judiciary. These scandals contributed to the dissolution of the Christian Democratic Party and the Socialist Party and to the emergence of the Northern League, which demanded the separation of the North from the South to end the waste in the *Mezzogiorno*. An intervention to make the country more uniform may have increased internal divisions.

Chapter 8, "Unity, Not Uniformity," discusses how countries have promoted national integration by using a calibrated blend of spatially blind institutions, connective infrastructure, and spatially targeted interventions.

Source: WDR 2009 team.

a. Boltho, Carlin, and Scaramozzino 1997; Sinn and Frank 2001.

b. By that time, some critics of the *Mezzogiorno* policy demanded that funds assist outmigration (Lutz 1962).

Economic development of the *Mezzogiorno*

	1951–60	1961–70	1971–80	1981–90	1990
The South's share of the national total (%)					
Population	37.2	36.0	35.1	36.1	36.6
GDP per capita	54.5	56.6	58.6	58.2	56.7
Fixed investment	26.0	29.0	31.2	29.0	26.9
Unemployment					
South	9.1	6.4	9.6	16.3	19.7
Center-North	6.8	4.5	5.2	7.6	6.5

Source: Faini, Giannini, and Galli 1993.

professional, and technical services. Lower communication costs might be expected to lead to a footloose tradable service sector. But most communication-intensive industries remain strongly agglomerated.⁵¹ A main reason for the persistence of agglomeration economies in knowledge production is that verifying the quality of information requires understanding and relationships of trust. Informal networks work as screening devices to build up trust in a group of knowledge producers.⁵² And lower urban transport costs increase the size of networks.

What to do: transport policies in the developing world

What do these events and insights mean for developing countries? Trade costs have fallen because of lower transport and communication costs, higher quality, and faster speed. But all countries have not benefited equally. Transport costs have fallen faster where the demand for transport services is greater. Increasing scale in traded production has raised competitiveness and allowed scale economies in the transport sector. The resulting lower trade and transport costs encourage trade and allow greater

BOX 6.5 *Mobility with density in Hong Kong, China*

Hong Kong, China, in the second half of the 1970s, had real growth of about 10 percent a year, an influx of immigrants, and roaring demand for private cars. Car registrations more than doubled in a decade. The results were huge time losses for passengers and freight transporters and health costs of air pollution. The Transport Department in Hong Kong, China, reacted with draconian measures. In 1979, it defined a transport policy to increase road capacity, expand and improve the mass transit system, and better manage the road capacity.

The government trebled the annual license fee for cars, doubled the first registration fee (to 70 to 90 percent of the import price of a vehicle), and doubled fuel taxes. Private and public vehicle ownership fell quickly. In 1985 the share of private cars in registered cars had fallen to 50 percent, 10 percent of them taxis.^a The public transport system consists of a 74-kilometer underground mass-transit railway, a 34-kilometer heavy rail line (linking Kowloon with China), a 32-kilometer light-rail system in the northwest of the New Territories, and a

16-kilometer tram in the North Side of Hong Kong Island. Five private bus companies operate franchised services with more than 6,000 buses. They are complemented by minibuses (public light buses) with fixed fares and exclusive rights to provide service on certain routes. Entry to this submarket is strictly regulated, with a maximum number of minibuses set for the city's quarters.^b Switching between different modes or submodes does not lead to big time losses.

Road pricing failed politically in 1985. One reason was the opening of the Island Route of the Mass Transit Railway, which carried about a quarter of all public transport boardings in 1988, and the Island Eastern Corridor a year earlier. Both eased congestion. Today, road charges in Hong Kong, China, are seen as a device not to reduce congestion but to curtail air pollution and maintain the city's attractiveness. It ranks fifth in the infrastructure index of the global competitiveness report, with a score of 6.2 out of 7, and first in product market efficiency and financial market sophistication.

The experience in Hong Kong, China, provides these lessons for the rapidly growing cities in the developing world:

- There is a limit to mobility and accessibility by private car in megacities. Even without congestion charging and the pricing of parking, strong fiscal disincentives can contain motorization in a phase of rapid income growth and limit the share of private cars in urban transport.
- Buses, and particularly minibuses, can be regulated to avoid congestion and high travel costs. Even with regulation, almost all public transport can be profitable.
- Along with policies to contain motorization, new traffic management instruments can make more effective use of existing infrastructure.

Chapter 7 discusses, for countries at various stages of urbanization, the institutions, infrastructure, and incentives that can facilitate concentration without congestion.

Source: WDR 2009 team.

a. Hau 1990.

b. Cullinane 2002.

specialization and exchange. Some countries such as China and Chile have broken into international markets and benefited from lower transport costs. But most of the others have not. In much of Africa, this cumulative causation has hurt, not helped, because agglomeration economies in Africa's divided neighborhoods remain small.

By increasing local market interactions and reducing intercity and interarea distances and international divisions, transport policies in developing countries can get these virtuous circles started. Improving physical infrastructure is an indispensable part of transport policy. Indeed, chapters 7, 8, and 9 discuss the need for spatially connective infrastructure in the local, national, and international contexts. But other important aspects of transport and communications policies are often neglected.

The new economic geography has highlighted what transport costs do for economic growth. Inadvertently, though, it

has contributed to an exaggerated focus of transport policy on *physical* improvements. And by using techniques that essentially assumed away the internal workings of transport—the goods to be transported are seen as an iceberg to be hauled from one place to another, and transport costs are the part of the iceberg that melts away—the most critical policy-related aspects also have been assumed away. The fundamental features that deserve the attention of policy makers are the scale economies in the transport sector that tend to create monopolistic behavior, and the circular causation between lower transport costs and greater trade and traffic. Another underemphasized aspect is the external cost of transport and communications, notably the congestion, pollution, and safety-related hazards.

The two neglected policy priorities are (1) reducing the negative effects of market structure in the transport sector and (2) improving trade facilitation and regional

coordination. Both will promote agglomerative forces and will sometimes provide greater payoffs than more physical infrastructure investments. A third policy priority is to address the negative externalities in transport.

Regulating transport to get the benefits of scale economies

Markets for transport services rarely are perfectly competitive, with major differences between the different modes. Competition in the trucking industry increased because of deregulation,⁵³ but there is a tendency toward consolidated ownership in many countries. In railways and airlines, markets remain dominated by state-owned enterprises.⁵⁴ In the airline and maritime transport industries, market segmentation allows providers to discriminate between different goods.⁵⁵ These observations suggest firm-level size advantages in transport operations.

Transport providers consolidate power by owning infrastructure. In 1980 the top 20 percent of the world's carriers controlled just 26 percent of the global port slot capacity. By 1992 this had increased to 42 percent, and by 2003, to 58 percent. It may be even higher today.

Infrastructure services are not provided in competitive markets because the indivisibility of infrastructure facilities naturally precludes competition. At early stages of development, the demand for ports, roads, and telecommunication equipment does not exhaust minimum capacities. As traffic increases, so does productivity. This is ultimately balanced by increasing time losses caused by congestion—as diseconomies of scale set in. Recent developments have made the advantages of large ports and airports even more pronounced—and the technological progress in shipping has reinforced the cost advantages of large ports (see box 6.3). Assessing the size of these scale effects is a daunting task, but studies have confirmed economies of scale and spotlighted the indivisibility of transport infrastructure.⁵⁶

A second reason for limited competition arises from “network economies.” Adding a link to a road or rail network does not just provide the benefits of connecting two

places—it increases the value of all other related connections by enhancing overall connectivity. These effects can be large. One estimate of the infrastructure-productivity link for India found a sizable externality of transport infrastructure. By providing a 5 percent rate of return on road infrastructure investment over and above the direct payoff, the network-related benefits accounted for almost a quarter of the overall increase in infrastructure productivity.⁵⁷

The absence of effective regulation limits competition in the transport sector and can reduce the construction of new infrastructure. It may cause underinvestment in maintenance of existing infrastructure. A number of studies have confirmed the tendency to underprovide transport and telecommunication infrastructure in developing countries.⁵⁸ Underinvestment in infrastructure maintenance can be even more severe. Actual expenditures for road maintenance in Africa, for example, appear to have systematically fallen short of planned figures.⁵⁹ It was estimated that \$45 billion was lost in road stock value during the 1970s and 1980s, which could have been avoided by spending \$12 billion for preventive road maintenance. Badly maintained roads increase transport costs by increasing costs of maintaining vehicles and reducing their speed. The direct costs of badly maintained roads are thus higher than the losses in cost-based road asset values as recorded by the road administrations. On top of this, higher transport costs slow the spatial transformation and reduce gains from specialization.

The monopolistic sector also encourages corruption. In smaller markets, users often have no substitutes for the services of large ports and airports. The higher these substitution costs, the higher the potential for high markups or bribes, depending on whether the infrastructure is private or public. How much rent-seeking increases transport costs is difficult to estimate. But a recent World Bank study that reviewed the main road corridors in all the regions of Sub-Saharan Africa reveals big gaps between prices for transport services and their costs (see table 6.1). The surplus is shared among bribes, regulatory rents, and transport company profits.

Table 6.1 Prices, costs, and profit margins are all high on Africa's transport corridors

Corridor (countries)	Route (gateway–destination)	Price ^a (US\$ per kilometer)	Variable cost (US\$ per kilometer)	Fixed cost (US\$ per kilometer)	Profit margin ^b (percent)
West Africa (Burkina Faso, Mali, and Ghana)	Tema/Accra–Ouagadougou	3.53 (2.01)	1.54 (0.59)	0.66 (0.64)	80
	Tema/Accra–Bamako	3.93 (1.53)	1.67 (0.23)	0.62 (0.36)	80
Central Africa (Cameroon, Central African Republic, and Chad)	Douala–N'Djaména	3.19 (1.10)	1.31 (0.32)	0.57 (0.30)	73
	Douala–Bangui	3.78 (1.30)	1.21 (0.35)	1.08 (0.81)	83
	Ngaoundéré–N'Djaména	5.37 (1.44)	1.83 (0.25)	0.73 (0.44)	118
	Ngaoundéré–Moundou	9.71 (2.58)	2.49 (0.64)	1.55 (0.43)	163
East Africa (Kenya and Uganda)	Mombasa–Kampala	2.22 (1.08)	0.98 (0.47)	0.35 (0.14)	86
	Mombasa–Nairobi	2.26 (1.36)	0.83 (0.17)	0.53 (0.19)	66
Southern Africa (South Africa, Zambia, and Tanzania)	Lusaka–Johannesburg	2.32 (1.59)	1.54 (0.41)	0.34 (0.40)	18
	Lusaka–Dar-es-Salaam	2.55 (0.08)	1.34 (0.52)	0.44 (0.51)	62

Source: World Bank 2008d.

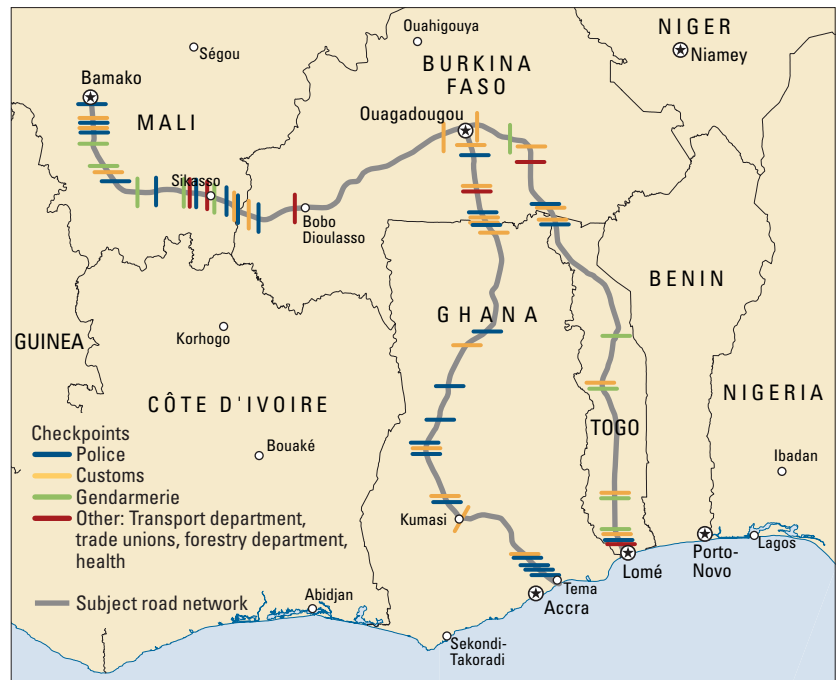
a. Some indicative prices are set by some ministries of transportation in Africa but are not used. Prices set by freight allocation bureaus in Central Africa may be more respected.
 b. Data should be interpreted cautiously since some companies may omit some costs or, on the contrary, double count some costs.

Transport infrastructure and service providers are not the only ones extracting bribes and enjoying extranormal profits. The Improved Road Transport Governance Initiative in West Africa monitors road practices harmful to trade on interstate trunk roads between Burkina Faso, Ghana, Mali, and Togo (see map 6.2). In Mali, truckers face 4.6 checkpoints, pay \$25, and waste 38 minutes for every 100 kilometers traveled. Internal or distance-related costs are compounded by costs imposed by the divisions of international borders.

National efforts and regional coordination to facilitate trade

Trade facilitation has become the most important policy instrument to achieve gains from international trade—improving the efficiency of ports, harmonizing standards, reducing bureaucratic burdens to cross borders, and coordinating behind the border regulatory norms (see box 6.6). Since August 2004, trade facilitation has moved to the center of the Doha Round

Map 6.2 Crossing borders or climbing walls?
 Checkpoints on priority transport corridors



Source: Improved Road Transport Governance Project, USAID West African Trade Hub 2007.

BOX 6.6 *Neighborhoods matter, but so do trade and transport policies*

Proximity to prosperous places can be a blessing, and to poor places, a curse. The box map illustrates the advantage of being in good neighborhoods. It shows the foreign market potential across the world, using an index that combines geographic proximity (distance) and policies to reduce trade barriers (divisions).

But good location is not enough. Even within the geographically fortunate

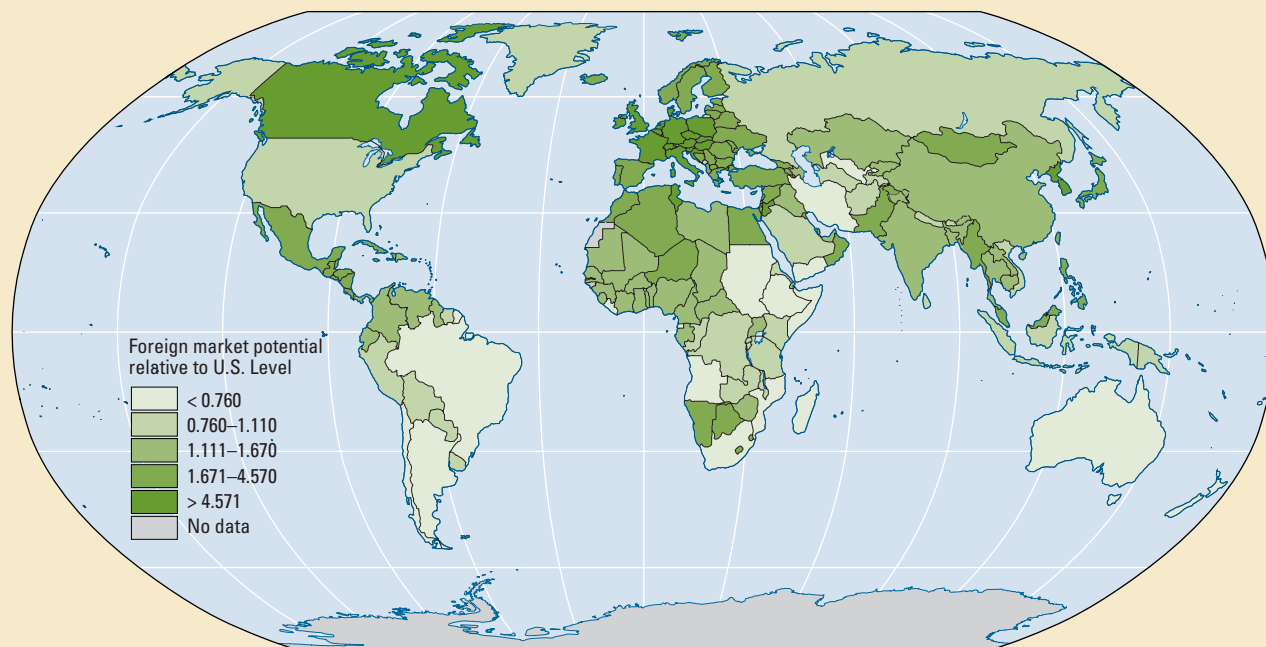
neighborhoods of Central America, North Africa, and Southeast Asia, Mexico, Tunisia, and Malaysia have the highest market access. Their rankings in the World Bank's *Doing Business* indicators—especially those related to trading across borders—are among the highest in their regions. Unsurprisingly, their recent growth performance has been impressive, and their living standards have improved.

Algeria and Indonesia have the same location as Tunisia and Malaysia, but they do not do as well in business and trade policies. Their market access indicators are accordingly lower than those of their neighbors. Sri Lanka and Ghana also do not do well in market access; they have good business and trade policies, but are not fortunate in location.

Sources: Mayer 2008; World Bank 2007d.

Being near prosperous places is important, but not enough

Foreign market potential, 2003



Sources: Mayer 2008 for this Report.

Note: To compute foreign market potential, each country is assigned a score for the size of international markets with which it can trade. This is computed by weighting the GDP of other countries by the inverse of a measure that combines physical distance, transport costs, and barriers to trade to show how difficult it is to access these markets. The measure, which is expressed relative to the foreign market potential of the United States, essentially combines the two spatial dimensions of distance and division into a composite of potential market access that does not include the effect of the home market (density). This map is a complement to map 9.2 showing Real Market Access.

of the World Trade Organization. Recent World Bank studies have identified several measures of trade facilitation as the main entry points for policy reform:

- *Port efficiency*—an average of the efficiency of port, inland waterway, and air transport facilities, based on data from the *World Competitiveness Report*
- *Customs regimes*—the hidden import barriers other than published tariffs and quotas, and irregular side payments

or bribes connected with import and export permits

- *Information technology (IT) infrastructure*—a measure of the speed and the cost of Internet access and the contribution of the Internet to the reduction of inventory costs

Improving trade facilitation capacity in 75 countries to half the global average could, as one study suggests, yield a \$377 billion increase in world trade.⁶⁰ Another study

showed that new and old EU member countries would benefit from trade facilitation measures in what were then the accession member countries, Bulgaria, Romania, and Turkey.⁶¹ If these countries reached half the trade facilitation standards of the EU-15 in terms of port efficiency, IT infrastructure, customs regimes, and harmonized regulation, it would lead to \$10 billion in overall trade gains. Among the four dimensions of trade facilitation, improvement of IT infrastructure would result in the highest trade gains (40 percent) followed by port efficiency improvements (30 percent).

Port efficiency improvements require both institutional and infrastructure investments. Maritime transport accounts for 90 percent of world trade by volume.⁶² Access to a well-run port may not guarantee export-oriented agglomerations, but these agglomerations certainly will not emerge without it. Private participation will be feasible where trade volumes are sufficiently high, but public support is

needed elsewhere. This is also true for other hub infrastructure such as airports, which are increasingly important for trade in low-weight, high-value goods and to support booming export-oriented services that need efficient air travel. In 2007 passenger traffic at Bangalore's airport jumped 35 percent.

With the fall of effective rates in international freight transport, time costs in international transport have become more important relative to the direct money costs.⁶³ International transport suffers from the extra time cost of border-crossing procedures. These time costs depend not just on the customs and fiscal rules of crossing the border but also on a host of behind-the-border elements concerning regulation and the supply of services.⁶⁴

Among the poorest performers: the time costs of transport range from 46 days in the Democratic Republic of Congo to 104 days in Uzbekistan, set against the Organisation for Economic Co-operation and Development (OECD) average of 9.8 days (see table 6.2).

Table 6.2 Time costs for crossing borders are highest in Central Asia, Central Africa, East Africa, and Southern Africa

Country	Documents for exports	Days	Country	Documents for imports	Days
Iraq	10	102	Uzbekistan	11	104
Kazakhstan	12	89	Chad	9	102
Tajikistan	10	82	Iraq	10	101
Uzbekistan	7	80	Tajikistan	11	83
Chad	6	78	Kazakhstan	14	76
Afghanistan	12	67	Kyrgyz Republic	13	75
Angola	12	64	Afghanistan	11	71
Kyrgyz Republic	13	64	Burundi	10	71
Eritrea	9	59	Eritrea	13	69
Niger	8	59	Rwanda	9	69
Mongolia	10	58	Niger	10	68
Central African Republic	8	57	Zimbabwe	13	67
Azerbaijan	9	56	Central African Republic	18	66
Zambia	8	53	Congo, Dem. Rep. of	9	66
Haiti	8	52	Venezuela, R.B. de	9	65
Zimbabwe	9	52	Mali	11	65
Congo, Rep. of	11	50	Zambia	11	64
Lao PDR	9	50	Congo, Rep. of	12	62
Burundi	9	47	Mongolia	10	59
Rwanda	9	47	Angola	9	58
Congo, Dem. Rep. of	8	46	Azerbaijan	14	56

Sources: World Bank 2007d.

Most of the slowest border crossings occur in Sub-Saharan African or Central Asian countries, many of which are landlocked. Having little control over other aspects of trade costs, such as transport over land to the nearest port, landlocked countries could be more aggressive with the trade facilitation policies that they do have control to improve. They could also benefit from a more explicit regional perspective. A variety of transit rules are recognized by international law and declarations, such as the “Almaty Programme of Action.”⁶⁵ Corridor facilitation and monitoring initiatives, such as those envisaged under the Sub-Saharan Africa Transport Program, could reduce the risk of coordination failures, but enforcement has been weak.⁶⁶

Even for fairly small coastal countries, regional approaches can be beneficial. Since increases in trade produce scale economies in transport, hub infrastructure is most beneficial if it is shared by as many market participants as possible. Few countries in West or East Africa, if any, can support a medium-size, deep-water container port on their own. But a shared port with a large catchment area would be more likely to support agglomeration, if costs and access are distributed among coastal countries and their landlocked neighbors. Sharing is not easy, however, because of the domestic bias of national infrastructure policies.

Addressing the negative externalities of transport

Efficient transport provides external benefits that go beyond simple time savings or lower maintenance; these benefits are often underappreciated. But transport also has external costs that usually are not internalized by transporters and traders.⁶⁷ Congestion and greenhouse gas emissions affect both developed and developing countries, but the direct health-related costs of pollution and poor safety are generally highest in developing countries.

Congestion. The lumpiness of transport infrastructure implies that there is no smooth and immediate supply response when demand increases. With overcapacity, the extra cost could be spread over a larger number of users. With insufficient capacity, congestion causes time and quality losses,

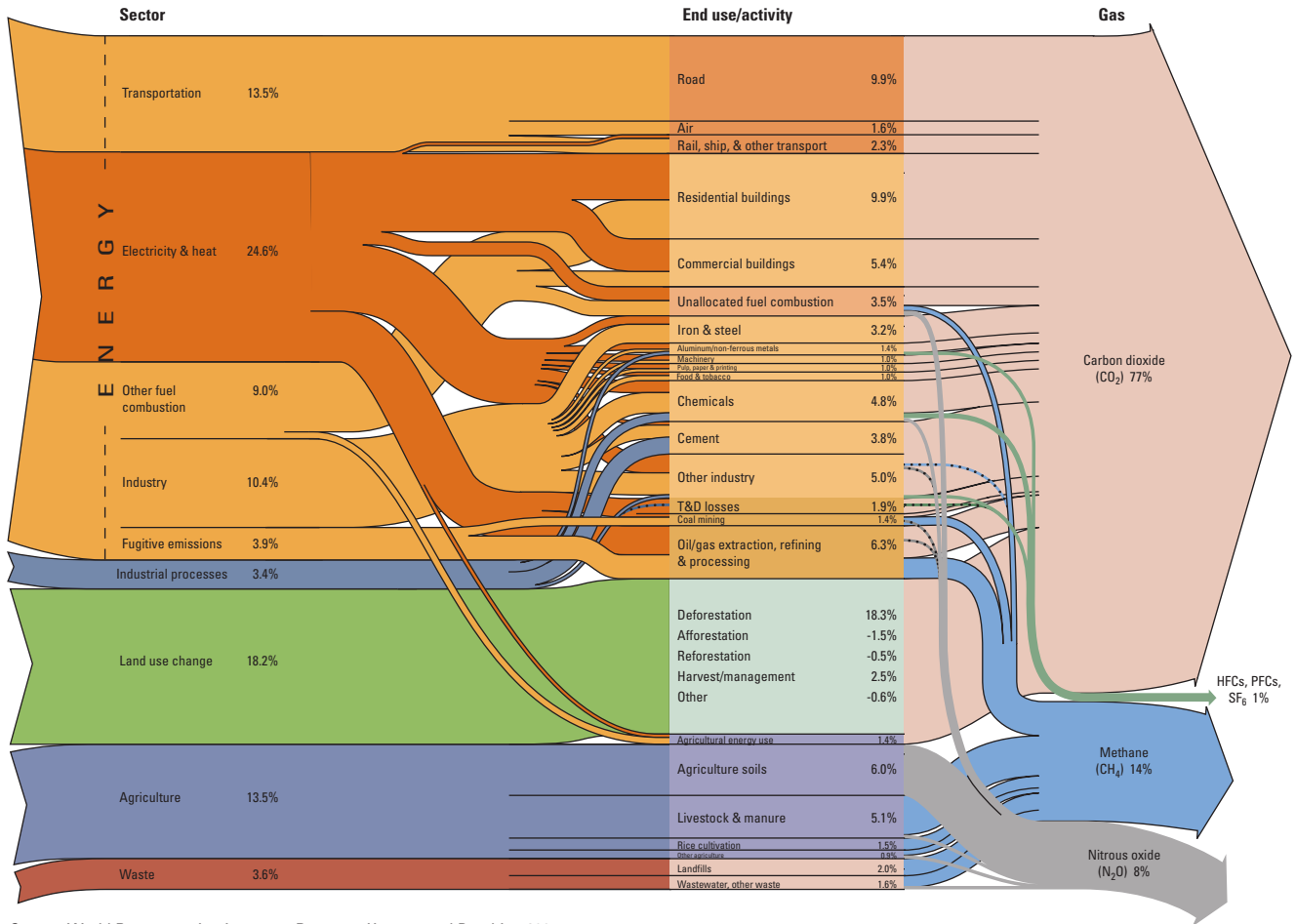
the case in many rapidly growing developing countries. Estimating the costs of congestion is not straightforward, because it occurs mostly during certain times of the day, often caused by specific bottlenecks in the network. One study of Washington, D.C., congestion put these costs at \$0.065 per mile.⁶⁸

Emissions. With growing concerns about climate change, the transport sector—a visible consumer of fossil fuels—has been getting more scrutiny. The largest share of these emissions is generated in industrialized countries. But with rising motorization in many developing countries, the world’s vehicle fleet will rapidly grow, and so will emissions. Most estimates of greenhouse gas emissions from transport are close to 13.5 percent of the total (see figure 6.6). One integrated assessment study puts the population-weighted expected global costs of a 2.5° C warming in 2100 at 2 percent of world GDP.⁶⁹ Half of this is caused by abrupt climate change, including the possible spread of tropical disease, especially in Africa. Other costs are incurred in agriculture (less than 10 percent) and from rising seas (6 percent).

What would internalizing these costs mean for the overall costs of transport? Estimates vary. A meta-analysis of earlier estimates suggests a current upper bound of \$50 per ton of carbon.⁷⁰ The *Stern Review* (2007) puts the total damage from future warming at 5–20 percent of world GDP in perpetuity and infers a current social cost equivalent of \$311 per ton of carbon. With a gallon of gasoline containing 0.0024 tons of carbon, damage of \$50 per ton of carbon would translate into \$0.12 per gallon of gasoline (or \$0.03 per liter) and damage of \$300 into \$0.72 a gallon (\$0.19 a liter). Internalizing the carbon dioxide (CO₂) costs of transport would thus increase transport costs by an amount well within historical gasoline price variations. Efforts to increase fuel efficiency have been under way for the past three decades, aided at least as much by fuel taxes and efficiency regulations as by the rising price of oil.

Pollution. Gasoline vehicles emit carbon monoxide (CO), nitrogen oxides (NO_x), and hydrocarbons (HC). CO reduces oxygen in the bloodstream, causing breathing

Figure 6.6 Transport accounts for about one-seventh of CO₂ emissions
Sources of greenhouse gas emissions, 2005



Source: World Resources Institute; see Baumert, Herzog, and Pershing 2005.

difficulty and cardiovascular damage. HC and NO_x combine to form ozone, making breathing harder and reducing visibility. NO_x and HC also react to form fine particulate matter (PM_{2.5}), small enough to enter lung tissue and increase mortality risks. Vehicle emissions of all local pollutants have fallen in developed countries, but they remain high elsewhere. Diseases related to air pollution contribute to the premature death of more than half a million people each year, imposing a cost of up to 2 percent of GDP in many developing countries. Transport may be responsible for about a quarter of this impact, mainly from private and commercial vehicles.⁷¹

Accidents. Similar to local air pollution, developed countries with high but stable motorization have reduced road fatalities

and injuries. But in developing and transition countries, these rates are increasing. The rate of road fatalities in the Russian Federation, for example, is five times that of the Netherlands. Some 1.2 million people die in road accidents each year, and 90 percent occur in low- and middle-income countries. World Bank projections suggest an increase by more than 80 percent between 2000 and 2020 in these countries, but a decrease of 30 percent in high-income countries. For every death, there are many cases of injury and disablement. Projected health losses from traffic accidents as a share of the total health losses are highest in the Middle East and North Africa (5 percent)—expected to rise to 8 percent—followed by Latin America and the Caribbean and East Asia and the Pacific (3

BOX 6.7 *Unclogging Latin America's arteries: transport costs now matter more than tariffs*

For the last two decades, the trade policy agenda of Latin America has been dominated by traditional market access and policy barriers issues. It has paid off. Tariffs have come down a lot. Most-favored-nation tariffs fell from more than 40 percent in the mid-1980s to close to 10 percent by 2000. Still, trade agreements continue to dominate policy discussions in the region.

But transport costs are now more important than tariffs. Simple averages of import ad valorem freight range from 6.5 percent in Argentina to 12 percent in Colombia for intraregional freight, and from 7.5 percent in Uruguay to 25 percent in landlocked Paraguay. Freight costs in Latin America and the Caribbean for exports to the United States are—with the exception of Bolivia, Mexico, and República Bolivariana de Venezuela—even higher than intraregional freight.

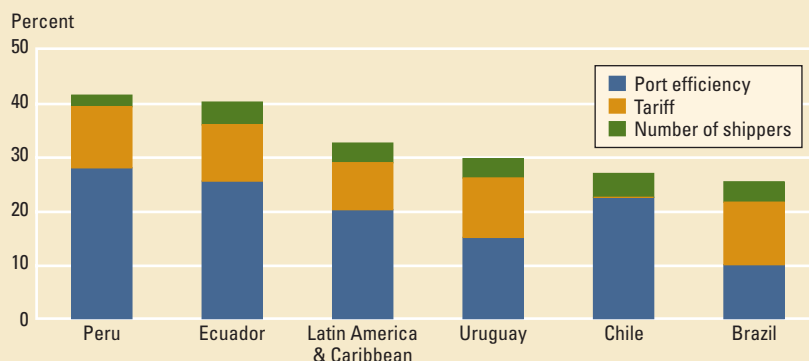
Low port efficiency and weak competition in the maritime transport sector seem to be the culprits (see figure to the right). On average, transport costs in Latin America would decline by 20 percent if countries in the region had U.S. levels of port efficiency.

A reduction of transport costs would bring about substantial benefits. A 10-percent decrease in trade costs would increase the region's imports by 50 percent and intraregional exports by more than 60 percent. The benefits of better transport policies seem to be much larger than lower tariffs. Compared with a similar

reduction in tariffs, the benefits of a fall in transport costs for intraregional exports are almost five times larger and lead to an increase in the number of products exported to the region, which is nine times bigger than a similar reduction in tariffs.

Source: Inter-American Development Bank, forthcoming.

Transport costs now matter more for trade
Percentage change in transport costs by making port efficiency, tariff rates, and number of shippers the same as U.S. levels, base year 2005



Source: Inter-American Development Bank, forthcoming.

percent), then Africa, Eastern Europe and Central Asia, and South Asia (2 percent).

Fatality risks are highest where motorization rates are rapidly increasing, because of long lags in implementing road safety measures. The transport sector can thus impose a cost on development. To what extent accident costs are “external” depends on how well insurance markets can cover the external costs, but even where those markets do not work well, road safety measures can protect pedestrians, cyclists, and other drivers from the reckless.

Transport: an increasingly important sector

For most modes of transport, costs have declined in many markets. Still, those costs are becoming a larger share of overall trade costs because of steeper declines in tariffs in regions such as Latin America and the Caribbean (see box 6.7). And with fuel costs rising, transport's share will rise even more.

What is needed for transport to continue to contribute to development?

Poor countries become big producers before they become big consumers. Income generation by importing intermediate goods and raw materials and exporting processed goods will be important. The relocation of intermediate production processes to middle- and low-income countries indicates the enormous potential benefits from integration into world markets even for these countries, limited mainly by transport and communications costs. But achieving this raises difficult institutional questions. The provision of access to foreign markets implies that some of the benefits of transport policies will accrue to foreign countries. Coordinating international transport policies thus requires a growing confidence in reciprocal support for international transport.

The increasing returns to scale in transport add two more coordination problems.

The scale of least-cost port and airport investments calls for hub-and-spoke transport systems in which neighboring countries share facilities. Because ownership of large infrastructure facilities provides market power, the sharing of facilities requires credible agreements. Increasing returns in transport operations—with maritime shipping supplied by a small number of firms and logistics services being consolidated in fewer hands—may require regulatory regimes to realize the potential for lower transport costs. The mutual dependence of transport policy and competition policy implies a global effort, such as that started by some multilateral organizations.

Transport and communication costs will remain a principal influence on the speed and efficiency of the spatial transformations needed for growth. Countries at different stages of transformation will have to formulate different policies for reducing transport costs. East, South, and Central Asia illustrate the contrasts:

- Developing countries in East Asia are now closer to world markets, as Japan and the Republic of Korea have prospered, and their transport costs to North America and Western Europe have fallen. They have joined the growing trade in intermediate and final manufactured goods. Countries such as Tunisia can do the same.
- In South Asia, falling trade and communication costs have helped India enter western markets for intermediate services, eliminating some of the disadvantages of being distant. Countries such as South Africa can do the same, exploiting their home market potential.
- In Central Asia—with economies that are small, landlocked, and dependent on exports of primary products such as oil and gas—reducing transport costs will be more difficult. It will also be difficult for smaller countries in divided neighborhoods, such as Burkina Faso, Malawi, Niger, and Rwanda. These countries will need aggressive measures to lessen the trade friction, enforceable agreements with neighbors to share expensive infrastructure, and selected investments to encourage agglomeration and reduce the transport costs for primary goods exports.