3

Importance of Geographical Proximity in Trade

It is a commonplace of international economics that the world is getting smaller. Indeed, it is *the* commonplace of international economics.

Technological progress has been driving costs of transportation and communication steadily lower for a long time. One has only to mention such important technical advances of a century ago as the automobile and airplane. In recent decades we have seen further cost-saving advances in shipping: supertankers, roll-on/roll-off ships, and containerized cargo. Between 1920 and 1990 the average ocean freight and port charges per short ton of US import and export cargo fell from $95 to $29 (in 1990 dollars). Between 1930 and 1990, average air transport revenue per passenger mile fell from $0.68 to $0.11. Over this same period, the cost of a three-minute telephone call from New York to London fell from $244.65 to $3.32 (Hufbauer 1991, 26). Where shipping costs were once a large fraction of the eventual price of an item, by 1988 the $200 price of a videocassette recorder imported to the United States from Japan included less than 1 percent allocated to ocean transportation. Jet air shipping and refrigeration have changed the status of goods that had previously been classified altogether as not tradeable internationally. Now fresh-cut flowers, perishable broccoli and strawberries, live lobsters, and even ice cream are sent between continents (e.g., Allen 1994, 19-21; Cooper 1995, 363-64).[1] The continuing communications revolution, including faxes and the Internet, speaks for itself.

1. Krugman (1995a) argues that the ease and magnitude of world trade has done little more than return to the situation in 1913, approximately reversing the collapse of 1914-45. He points out that many of the most important technical advances occurred before 1870, such

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In large part because of the shrinking costs of doing business at a distance, people are now very aware of the economic effects that far-off events can have on them. An oil price shock originating in the Middle East, an upsurge in cheap, labor-intensive exports from China, a retrenchment by banks in Japan, financial volatility in London, a debt crisis in Mexico—each has a tangible impact on the livelihood of citizens in countries such as the United States that had previously thought themselves relatively immune from foreign developments.

It is easy to carry the theme of a shrinking world too far, however. Titles such as *The Borderless World*, ''The Death of Distance,'' and *Global Financial Integration: The End of Geography* are probably not intended literally.[2] But if the titles are intended literally, then they carry the theme too far. Distance and national borders both still matter, as we will document.

One way of measuring the remaining obstacles to international integration is to look at the inability of arbitrage to equate prices internationally. Even a commodity such as cocoa or copper delivered in London is not the same as cocoa or copper delivered in Chicago; prices in the two markets reflect a difference. For most goods, which are far less easily traded than basic agricultural and mineral products such as cocoa or copper, integration is much more incomplete. The obstacles to goods-market arbitrage across countries are so large that tests of this standard criterion of international integration were, until relatively recently, routinely unable to find any statistical tendency for relative prices to move toward purchasing power parity—that is, equal price levels measured in terms of the same currency. Even now, consensus estimates say that prices on average close only about 20 percent of a gap in a given year.[3] A recent historical study of prices in England and Holland since 1273 for eight specific commodities (barley, butter, cheese, eggs, oats, peas, silver, and wheat) reveals a surprising conclusion: the deviations from the so-called Law of One Price are no smaller or less persistent now than they were in past centuries. Evidently, whatever tendency technological progress has had to enhance international arbitrage in these commodities has been counteracted by greater roles for government trade barriers or exchange rate volatility (Froot, Kim, and Rogoff 1995).

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as steel-hulled ships, the screw propeller, and the trans-Atlantic telegraph, which was laid in 1866. Irwin (1996) argues similarly. Cooper (1995) argues that the technological progress of this century has had more of an effect than Krugman admits.

2. By Omae (1990), *The Economist* (30 September 1995, 5-28), and O'Brien (1992), respectively. Omae writes (172) ''. . . national borders have effectively disappeared and, along with them, the economic logic that made them useful lines of demarcation in the first place.'' The latter two titles have been taken somewhat out of context. They are actually about telecommunications and financial services, respectively, not merchandise trade. Even in financial markets, however, integration is not literally perfect, as is borne out by empirical evidence of international differences in interest rates and of home-country bias in the holding of securities.

3. Frankel and Rose (1996) give further references.

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The statistic that most readily illustrates the increased openness of most countries—the ratio of trade to income—also illustrates how far we are from a world without borders. US merchandise exports and imports (averaged) have doubled as a share of GDP, from 4.2 percent in 1971 to 8.4 percent in 1993. The numbers for Japan and the European Union (that is, all 15 countries, netting out intra-EU trade) are comparable: 7.2 percent and 8.5 percent, respectively, in 1993. Does the increase in these figures mean we are close to a world in which people buy and sell goods from abroad as easily at home? Do businesspeople trade around the globe as easily as around the block? Far from it. The United States accounts for 26 percent of gross world product, Japan 15 percent, and the European Union 30 percent (evaluated at recent exchange rates). If purchases and sales took place in simple proportion to income and output, unaffected by geography, then US openness would be 74 percent (1 = .26), EU openness would be 70 percent (1 = .30) and Japan's 85 percent (1 = .15). But we just noted that these openness statistics are in fact about 8 percent in each of the three parts of the world. By this measure, then, openness would have to increase by roughly a factor of 10 before we could claim a fully integrated world economy! Clearly, geography still matters.

Why Geography Should Be Part of Trade Theory

As surprising as it sounds, most international economists until quite recently ignored distance and other geographical factors as determinants of trade. Trade models vary along many dimensions: Some are empirical, and some theoretical. Some are designed to describe a number of large countries, and some to describe one small country. Some assume imperfect competition among firms, and some perfect competition. Some are based on economies of scale as the motive for trade, and some on differences in factor endowments and other sources of inherent comparative advantage. They vary along other dimensions as well. Yet most trade models have until recently had one thing in common: they treated countries as disembodied entities that lacked a physical location in geographical space.

We will see that one cannot get very far into an empirical analysis of bilateral trade—that is, an analysis of trade between pairs of countries—without recognizing the strong, inhibiting effect of distance on trade. How then could so much of earlier research have omitted this obvious factor? The simplest answer is that earlier research did not try to explain quantities or composition of bilateral trade. Its goal, rather, was to explain the quantities and composition of the *total* trade undertaken by a country, regardless of which trading partners accounted for it.

Classic trade theory seeks to predict, for example, what products China will export (answer: apparel, because it is intensive in unskilled labor,

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which is abundant in China). It also seeks to predict what products Japan will import (again apparel, because Japan no longer has much unskilled labor). The classic trade theory does not usually pay attention to the question of whether clothing is exported specifically from China to Japan. Rather, it is content with predicting that China adds a certain quantity of apparel to the world's supply pool and that Japan buys a certain quantity of apparel from that pool. As to whether China will export its goods specifically to Japan or France, and as to whether Japan will buy from China or Morocco, the theory is silent.

Paul Krugman addresses this question of why earlier research was not interested in explaining bilateral trade, or in addressing any geographical dimensions of trade. His point is that, until recently, the standard theories of trade were based on the assumptions of perfect competition and constant returns to scale. It is difficult to analyze many geographic influences with such models. The assumptions of imperfect competition and increasing returns to scale are needed for modeling questions such as where industries choose to locate. We have all heard about the person who loses a silver dollar one night and looks for it on the next street over from where he lost it because that block is the only one that has bright street lights. Similarly, international economists did not investigate the important questions of geography because they lacked the analytical tools (see discussion in Krugman 1991c, 1995b, 1996).[4]

There are at least three sorts of reasons one should care about bilateral patterns of trade, the role of distance in particular, and about geography in general.

Let us first note a spurious reason. We hope readers are interested because they think that bilateral trade *balances* are important, except in the narrow political sense that bilateral balances are important because the electorate thinks they are important. It is true that a US trade deficit is a subject of concern to the extent that the excess of spending over income that this deficit represents does not have a worthwhile origin. A high trade surplus in Japan might also be a subject of concern—unless one thinks that the high saving rate that brought it about is a good thing. Even so, the bilateral trade balance between Japan and the United States is a needlessly inaccurate reflection of their respective overall balances. The overall US deficit and the overall Japanese surplus are the only valid subjects of interest. To think otherwise is to think it important that each source of spending match each source of income. It would be as if one refused to pay one's hairstylist in money and instead insisted that he accept payment in the form of the services of one's own profession. Life would be rather inconvenient, having to search for a hairstylist willing

4. The model that we develop in chapter 7 is Krugmanic.

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to do business under such terms. Better to sell one's services where they are wanted and use the proceeds to pay the hairstylist.

Even worse than concerns in public debate with bilateral balances over all products and services are concerns with bilateral balances in specific sectors. Some countries object when their citizens buy more automobiles from a particular trading partner than the citizens of the foreign country buy from domestic producers. But important gains from trade are to be had by trading in different products. Life would be particularly inconvenient if one gave up the option of getting one's hair cut beyond the number of times that one was prepared to cut someone else's hair in return. Thus, we will be focusing on bilateral trade in the aggregate, not bilateral balances.

The first valid reason for caring about the role of geography is that distance leads to agglomeration. Agglomeration in turn means that history can affect what goods are produced in a given region or country. Consider the case of an intermediate input. If there is a cost to doing business at a distance, there will be a tendency for the firms that are customers for the input to locate close to a supplier, and then for other suppliers to locate in the same area. A given firm chooses to locate in a given area because other firms are already located there. The result, as scholars of geography and urban studies have long known, is regional agglomeration. Krugman (1991c) has developed the implications theoretically, as well as illustrated the manifestations with examples that are all around us. Examples include the famous tendency for the computer industry to cluster in Silicon Valley in California or around Route 128 in Massachusetts, for the auto industry to concentrate in the Midwest, for the carpet industry in Georgia, and so on. In many cases, the tendency toward concentration originally began with a single chance event.

The effect works internationally as well. A city-state such as Singapore owes its success in part to the forces of agglomeration, together with the benefits, as the real estate agent mantra goes, of ''location, location, location.'' The Chinese city of Shenzhen, across the border from Hong Kong, owes its entire existence to these benefits. The very high amount of trade among the Benelux countries and Germany largely reflects a concentration of heavy industry analogous to that in midwestern American states (Krugman 1991c, 1995a). As a result, the question of what goods a country will produce is often answered by historical accident more than by innate comparative advantage based on intrinsic endowments.[5]

5. This is a lively little area for current research. Krugman and Venables (1995) show how transport costs affect international agglomeration in manufacturing. When transport costs are high, all countries have some manufacturing, but as transport costs fall below a critical value, a core-periphery pattern forms. Brainard (1993) shows how transport costs affect the decisions of multinational corporations to locate production overseas. Hanson (1994) applies the agglomeration concept to show the implications of liberalization and NAFTA for the regional location of the Mexican apparel industry.

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The second reason to care about distance and location is much less cosmic in scope but is the central point that this chapter contributes to the logic of the book. Distance between a pair of countries is an important natural determinant of the volume of trade between them. We need to isolate this factor before we can look at others. Thus, when looking at trade data, correcting bilateral data for distance is a helpful way of answering other questions. Examples include the questions of whether rich countries trade more than poor ones, or whether a country such as Japan is an outlier in global trade patterns.

In particular, we wish to measure empirically the extent to which preferential trade policies are influencing bilateral trade patterns. To do so, we must hold constant for the distance between the two countries and related factors such as whether or not they share a common border. In terms that were introduced in the preceding chapter, our plan is to apportion the observed regional concentration of trade between the Krugman-Summers explanation (proximity) and the Bhagwati-Panagariya explanation (existing regional trading arrangements).

The final reason to care about distance and location bears directly on the central point of this book, which will be developed in later chapters, particularly in chapter 8. We will see that countries that are located close together constitute a natural trading bloc, by which we mean that a reduction in trade barriers between them can be economically beneficial. We will also develop the notion of the optimal degree of regionalization of trade policy, which is the maximum amount of preferences that can be justified by geography. It will turn out that the more sharply transportation costs rise per kilometer of distance, the higher the optimal degree of regionalization, if other things are equal.

Three Kinds of Costs to Doing Business at a Distance

In a classic study of bilateral trade, Linnemann (1966) identified three categories of costs associated with doing business at a distance. We will call them physical shipping costs, time-related costs, and costs of unfamiliarity. The first, shipping costs, is the most obvious.

Shipping Costs

Although transportation costs are obvious, how to measure them is not. The easiest way to get a comprehensive measure of shipping costs for a country's trade is the ratio of c.i.f. trade values (measured as the cost to the importing country including insurance and freight) to f.a.s. or f.o.b. values (measured as it leaves the exporting country—i.e., ''free alongside

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ship'' or ''free on board''). The difference, the cost of insurance and freight, ranges widely, depending on the context.[6] In general, US customs data show that transport costs for international trade exceed the cost of duties (Amjadi, Winters, and Yeats 1995, 475, 477). We display the recent figures pertaining to US imports from 63 countries in table 3.1. The c.i.f. margin ranges from 1.7 percent for close neighbor Mexico to 12.9 percent for distant neighbor Chile.[7]

An econometric attempt to explain the c.i.f./f.o.b. ratio (in log form) by distance from the United States to the trading partner produced the following results. First, the log of distance fits slightly better than the level of distance. Second, in most years (1989-94), the point estimate of the coefficient on the log of distance is slightly above 1.0. This suggests that aggregate transportation costs rise, very roughly by about 1 percent of value when distance increases by 1 percent. Third, the coefficient is not estimated with any precision when the c.i.f./f.o.b. ratio is computed for the aggregate of trade across all commodities, as in table 3.1. Fourth, the coefficient is more often statistically significant when the transport cost margin is computed for a disaggregated commodity. For example, the cost of transport for mineral fuels, mineral oils, and products of their distillation (Standard International Trade Classification 27) has a significant coefficient of 5.3 in 1994. Clearly, trade among distant countries tends to be relatively concentrated in goods that are easier to transport (relative to their value) as compared with trade among close countries. This composition problem suggests that the aggregate c.i.f./f.o.b. numbers can be seriously misleading.

The margins in the table pertain to the set of 63 countries that we use as the data base for our most important estimates in this book. A more complete set of all countries shows transport costs for imports to the United States in 1994 running as high as 21.9 percent for the Solomon Islands and 25.8 percent for Guinea. Interestingly, some countries that are even more remote than these two apparently have low aggregate shipping costs, such as the Central African Republic, Zambia, and Rwanda. The explanation is certainly again the commodity composition

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6. The c.i.f. difference was estimated by Linnemann at 5 percent for intra-European trade on average and 10 to 15 percent for intercontinental trade. These are the same two parameters that enter into the analysis of our chapter 8.

7. The figures pertain to 1994. Chile is followed by Ecuador (and then four Middle Eastern countries). In much of this book, we speak of South American countries as being in the same region as the United States. In fact, however, transportation costs between South America and North America are quite high, due in part to a highly regulated and cartelized shipping industry. We return to this point in chapter 11. Amjadi, Winters, and Yeats (1995) find that the transport costs are higher from South America to the United States than from Europe and suggests that therefore the Free Trade Area of the Americas is not a natural trade bloc.

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Table 3.1 Ad valorem transportation and insurance costs of US imports by country, 1992-94 (log ratio of c.i.f. value to customs value)

Country	1994	1993	1992
Chile	0.129	0.152	0.160
Ecuador	0.115	0.111	0.107
Kuwait	0.100	0.096	0.097
Morocco	0.093	0.084	0.089
Algeria	0.087	0.078	0.064
Tunisia	0.085	0.066	0.066
New Zealand	0.084	0.093	0.091
Greece	0.084	0.071	0.065
Egypt	0.079	0.079	0.069
Saudi Arabia	0.078	0.090	0.085
Poland	0.077	0.072	0.065
Australia	0.074	0.073	0.077
Indonesia	0.073	0.079	0.082
Turkey	0.072	0.068	0.065
Colombia	0.071	0.075	0.073
Venezuela	0.070	0.067	0.056
Spain	0.070	0.067	0.060
Pakistan	0.069	0.074	0.074
Uruguay	0.068	0.043	0.055
Kenya	0.068	0.084	0.067
Hungary	0.067	0.062	0.065
Finland	0.067	0.067	0.066
Brazil	0.067	0.072	0.068
India	0.066	0.070	0.073
China	0.064	0.066	0.065
Yugoslavia	n.a.	n.a.	0.065
Ethiopia (excludes Eritrea)[a]	0.062	0.059	n.a.
Ethiopia (includes Eritrea)	n.a.	0.082	0.043
Peru	0.062	0.059	0.055
Iceland	0.062	0.048	0.050
Argentina	0.061	0.073	0.088
Nigeria	0.060	0.057	0.044
Netherlands	0.055	0.049	0.045
Portugal	0.055	0.050	0.052
Paraguay	0.053	0.081	0.085
Norway	0.052	0.049	0.043
Philippines	0.052	0.056	0.059
South Africa, Republic of	0.048	0.043	0.041
Italy	0.048	0.045	0.043
Thailand	0.047	0.050	0.052
Taiwan	0.045	0.047	0.048
Hong Kong	0.045	0.045	0.046
Sudan	0.043	0.054	0.041
Denmark	0.041	0.045	0.040
Sweden	0.039	0.034	0.034
Austria	0.038	0.039	0.035
Korea, South	0.036	0.038	0.039

(continued next page)

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Table 3.1 (continued)

Country	1994	1993	1992
Ghana	0.035	0.046	0.061
Bolivia	0.031	0.028	0.031
Germany, West	0.029	0.029	0.026
Japan	0.027	0.029	0.031
Iran	0.025	0.032	0.023
Canada	0.023	0.024	0.028
Israel	0.022	0.023	0.024
Ireland	0.021	0.022	0.022
Switzerland	0.020	0.017	0.017
Singapore	0.019	0.020	0.021
Mexico	0.017	0.020	0.020
World	0.038	0.039	0.039

a. Eritrea left Ethiopia in 1993.

c.i.f. = costs, insurance, and freight; n.a. = not applicable

Source: US Commerce Department, Bureau of the Census, National Trade Data Bank.

of trade: costs are in fact so high for these landlocked African countries that only the most easily shipped goods are exported. This shows the limitation of using the c.i.f./f.o.b. numbers to measure transportation costs without disaggregating by commodity. (The worldwide average for the complete set of countries was 3.8 percent in 1994).

There is an even wider variation in shipping costs across commodities than across countries. We have broken down US imports by two-digit Standard International Trade Classification (SITC) categories. The c.i.f./f.o.b. estimate of transportation costs start from levels as low as 0.7 percent for pearls (which have a high ratio of value to weight), 0.8 percent for aircraft (which can fly themselves to their destination), and 0.9 percent for works of art and antiques (again a high ratio of value to weight; surprisingly, costs arising from insurance or the special needs of fragility seem to be minor in proportion to the value). At the opposite extreme, costs go as high as 19.3 percent for fruits and nuts (which are perishable), 20.9 for straw baskets and similar manufactures (low ratio of value to physical volume), and 25.1 percent for salt, sulfur, earth, stone, and plasterng material (which are heavy). The c.i.f. margins for the full range of commodities are reported in appendix table B3.1.

Figure 3.1 shows the aggregate worldwide c.i.f. margin from 1950 to 1993. It is substantially higher than for US imports considered alone. It has been falling steadily over the last 45 years. This reflects declining transport costs. One suspects that the decline in shipping costs per kilometer of a given commodity is offset to a degree by the (resulting) tendency to undertake trade in commodities that would have previously been deemed too expensive, and with partners that would have previously

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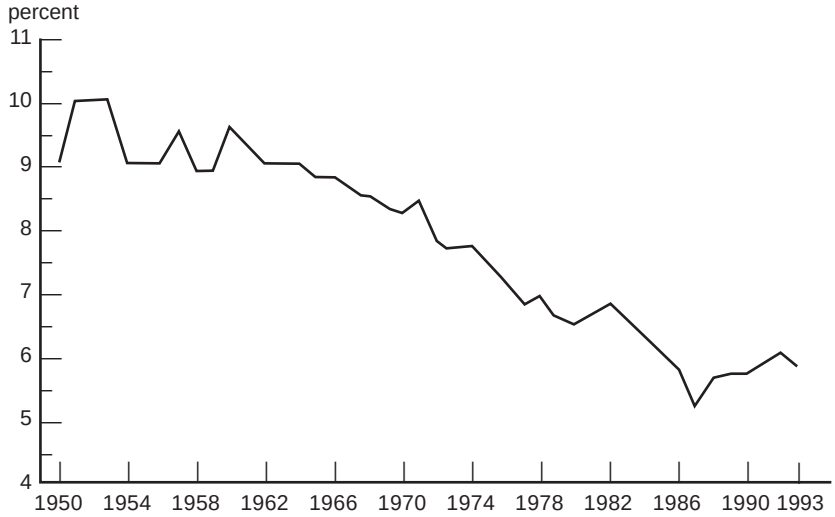
Figure 3.1 World transportation and insurance costs as a percentage of product value, 1950-93



Source: IMF, *International Financial Statistics Yearbook.*

been deemed too far away. This suggests that shipping costs have fallen more steeply than the figure indicates.

Boisso and Ferrantino (1996, figure 1) show that weighted-average distances between trading partners, where the weights are bilateral trade shares, have increased steadily in the postwar period. This illustrates two things. First, transportation costs and the other costs to doing business at a distance have continued to fall. This must be the reason trade is taking place over longer and longer distances. Second, a measure of weighted-average transportation cost, such as the ratio of c.i.f. value to f.o.b. value, will not give a good indication of the extent to which transport costs are falling over time. To repeat, precisely because trade takes place over increasingly large distances, the trend in the trade-weighted average of transportation costs will be biased upward as an estimate of the trend in transportation costs at a given distance.

Time Elapsed in Transporting

The second category of costs associated with doing business at a distance is the time element, which, like shipping costs, derives from the process of transporting the commodity. It includes interest charges, perishability, and the loss of adaptability to changing conditions that comes from long

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delivery lags. A firm will find it difficult to practice ''just-in-time'' inventory control if there is a long lag between the time a shipment is ordered and the time it arrives. An increasingly important concern in such industries as high-fashion apparel and sound and video recordings is that the product may have gone out of style by the time a shipment arrives.

Cultural Unfamiliarity

Linnemann called the third of his categories ''economic horizon'' or ''psychic distance.'' Here he had in mind that familiarity with another country's laws, institutions, habits, and languages is an important part of marketing. Drysdale and Garnaut (1982) call this ''subjective resistance to trade,'' as opposed to the other, distance-related factors, which they call ''objective resistance.'' We have all heard about such classic marketing mistakes as trying to sell Japanese consumers appliances that are too big for their kitchens or cars that have the steering wheels on the wrong side, or to sell Latin Americans a car with a name that in Spanish means ''doesn't go'' (*nova*). Cultural familiarity is highly correlated with geographical proximity, though history, language, and other factors matter greatly as well.

One may hypothesize, as a way of rendering psychic distance more precise, that the cost of human travel between countries is an important component of the cost of doing business. In the case of some services, such as tourism or consulting, the point is almost tautological; the trip is virtually what is being bought or sold. Human travel is a factor for other goods as well, whether they are commodities for which physical shipping costs are high, such as machinery, or are zero, such as financial and insurance services. Consider a kind of export important in the United States: high-tech capital goods. To begin sales in a foreign country may involve many trips by engineers, marketing people, higher ranking executives to clinch a deal, and technical support staff to help install the equipment or to service it when it malfunctions. Anecdotal evidence includes the example of a Korean company that would rather buy such equipment from a manufacturer in Japan than in the United States because service personnel can respond to distress calls in a matter of hours rather than days. One could conceivably try to distill the slightly nebulous psychic distance factor into hard numbers by counting the dollar cost of such human travel that firms incur in association with operating in particular foreign countries. One could try to add in the cost of mail, courier services, and telephone calls, all of which depend to some degree on distance.

Any such attempts at direct quantification, however, would inevitably neglect many intangible factors. One example is the inconvenience of communicating in real time with different time zones. Another is the high cost (as a percentage of value) to circulating newspapers over large

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distances. A third is radio and television transmission. Residents of East Germany stayed attuned to the culture of West Germany and the rest of the capitalist world, when physical cross-border travel was impossible, by listening to West German radio and television. This would have been much harder if the distance between the two Germanies had been greater. East German awareness of specific consumer products undoubtedly helped to speed economic integration with West Germany when the Berlin Wall came down. More fundamentally, it was also a factor in the easterners' rejection of communism. The farther away is the country in question, the less well-informed are domestic residents likely to be about its culture, politics, and economy.

Indirect Evidence on the Importance of Distance

Whether air travel is considered an important component of the cost of doing business internationally or merely an example of it, the volume of air travel between pairs of cities offers a fascinating illustration of the role of distance and a first look at the principles of the gravity model. Table 3.2 shows international air traffic, measured by the number of passengers traveling a route in 1992, for the top 25 pairs of cities.

If international airline travel were based solely on the size of the two cities in question, one would expect traffic among the 10 largest cities to account for most of the top 25 most-traveled routes.[8] Yet, of the 25 most-traveled international air routes, only 7 involve pairs of the 10 largest cities, such as London-New York. Most of the list involves such proximate city pairs as Singapore-Kuala Lumpur, Dublin-London, and Taipei-Hong Kong.[9] The lesson is that proximity is important, and in some sense is even as important as size, in determining economic transactions.

Perhaps the simplest proof that distance is still important is the observed tendency toward geographical agglomeration of industries, already noted above. The agglomeration occurs even in sectors where physical transport costs are negligible, as in financial services or computer software. Financial firms concentrate in Manhattan and computer firms concentrate in Silicon Valley. They do not choose to locate near each other because they are

8. Ten cities implies $45 = (10 \times 9)/2$ pairs of cities. Six of these 45 pairs turn out to lie within the same country; they should be excluded from the list because table 3.2 shows only international city pairs. Thus, of these, there are 39 among the top 10 cities, enough to fill the top 25 slots and then some.

9. We have chosen to rank cities by economic size (population times the country's GDP per capita, at current exchange rates). If we had instead ranked cities by population, then only one pair would have entered the top 25 air routes (and that one is a proximate pair: Seoul-Tokyo). Distance would look even more important.

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Table 3.2 International city pairs with the greatest air traffic volume, 1992

City Pair	Passengers (in thousands)
London-Paris	3,402
London-New York	2,276
Hong Kong-Taipei	2,233
Honolulu-Tokyo	2,131
Kuala Lumpur-Singapore	2,109
Seoul-Tokyo	2,023
Hong Kong-Tokyo	2,019
Amsterdam-London	1,775
Dublin-London	1,720
Bangkok-Hong Kong	1,649
Jakarta-Singapore	1,381
Singapore-Tokyo	1,256
Frankfurt-London	1,222
New York-Paris	1,218
Los Angeles-Tokyo	1,094
Taipei-Tokyo	1,090
London-Los Angeles	1,015
Brussels-London	1,015
Hong Kong-Manila	998
Hong Kong-Singapore	997
Bangkok-Singapore	982
London-Tokyo	951
London-Zurich	908
Bangkok-Tokyo	901
Guam-Tokyo	858

Source: ICAO Journal, July/August 1994, 15, cited in Hufbauer and Findlay (1996).

trading physical commodities with each other and wish to save on shipping costs. Rather, face-to-face contact is important for exchanging information and negotiating deals. Even the difference between a distance of one city block and two can be relevant sometimes. In corporate office buildings, government agencies, and universities, the proximity of one's office to the offices of key colleagues or superiors is considered a crucial aspect of one's job, and not solely for reasons of prestige.

The importance of distance is also revealed by analysis of data on prices of goods in different locations. If transport costs and other costs to doing business at a distance are important, then arbitrage should do a better job of keeping prices of similar goods in line when they are sold at locations close together rather than far apart. Engel and Rogers (1995) study consumer prices for 23 Canadian and US cities. They look at 14 consumption categories over 1978-94 and find that the distance between two North American cities has a significant effect on the variability of their relative prices (bimonthly changes). The equation holds constant for

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whether the two cities are on the same side of the border or not. The effect of a 1 percent increase in bilateral distance on the standard deviation of relative price changes is an estimated .0000260.[10] The average distance between US-Canadian city pairs is 1,346 miles. The upshot is that the estimated average cost that Canada-US city pairs pay as a result of not being located close together is to increase the variability by about one-fifth of the average standard deviation.[11] If the distance between the average pair of cities were to be doubled, then variability would further increase by about 3 percent.[12]

Engel and Rogers (1997) extend their results to a wider set of countries. They find that the log of distance has a statistically significant effect on relative price variability for seven out of nine industries tested. The impact of a 1 percent increase in distance is an increase in the annualized standard deviation of .0000273. This is nearly identical to the effect that Engel and Rogers found in their earlier study using US and Canada data.[13] The estimates hold constant for the effect of bilateral nominal exchange rate variability.

Wei and Parsley (1995, table 3) look at the variability in relative prices for given tradeable industries across 14 industrial countries. Other factors that affect relative price variability, and thus must be held constant when evaluating the effect of distance, include bilateral exchange rate variability (when the cities are located in different countries), common membership in the European Union or other trade blocs, and linguistic ties. Their estimate is that increasing the distance between two countries by 1 percent raises the standard deviation of (yearly) price differentials by .000063. In other words, the distance effects that they estimate from their worldwide data set are about twice as large as the effects estimated by Engel and Rogers.

In any case, the point is clear. The effectiveness of arbitrage diminishes as the distance between cities widens. Any model of bilateral trade must take distance into account.

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10. Annualized, this is the effect on bimonthly variability (.0000106) times the square root of 6, assuming that the bimonthly changes follow an approximate random walk.

11. The effect is an increase of .01825 in the annual standard deviation—that is, an increase in the monthly standard deviation of .00745 (7.03 $\times$ .00106. The average log distance is 7.03.)

12. In other words, if distance were increased by another 100 percent (logarithmically, i.e., from 1,346 miles to 3,659), the monthly standard deviation would go up by another .00106. The annual standard deviation would go up by another .00260.

13. A 1 percent increase in distance raises the monthly standard deviation by an estimated .00000789. This monthly number is multiplied by the square root of 12 to annualize it.

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