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Shipping Costs, Manufactured Exports, and Economic Growth¹

In the *Wealth of Nations*, Adam Smith put great stress on the relationship between geographic location and international trade. Smith observed that a more extensive division of labor was likely to develop first along sea coasts and navigable rivers, where transport costs were especially low:

As by means of water-carriage a more extensive market is opened to every sort of industry than what land-carriage alone can afford it, so it is upon the sea-coast, and along the banks of navigable rivers, that industry of every kind naturally begins to sub-divide and improve itself, and it is frequently not till a long time after that those improvements extend themselves to the inland part of the country.

Smith attributed the rapid development of civilizations around the Mediterranean basin to the relative ease of sea-based trade in the region. He saw the shortage of navigable rivers into inland regions of Africa as a detriment to development on that continent. He also noted the pattern of rapid development in the New World: “In our North American colonies, the plantations have constantly followed either the sea-coast or the banks of navigable rivers, and have scarce any where extended themselves to any considerable distance from both.” And so it was in the United States that the first and most extensive development was along the coast lines; the Mississippi, Ohio, and Hudson River valleys; and the Great Lakes region.

Are Smith’s observations of any relevance today? Are geographical location, especially access to the sea, still important determinants of a country’s development prospects? Though interest in transport costs has recently risen in the theory of international trade (see, for example, Krugman, 1996), there continues to be almost no empirical work on the role of shipping costs in patterns of trade and development.² In this paper we examine some empirical evidence on differences in shipping costs across developing countries, and its impact on manufactured exports and economic growth. We find that geographical considerations -- specifically access to the sea and distance to major markets -- have a strong impact on shipping costs, which in turn influence success in manufactured exports and long-run economic growth. Countries with lower shipping

¹ Thanks go to Mumtaz Hussain and Dilip Parajuli for excellent research assistance.

² The limited amount of empirical work on transport costs include Sampson and Yeats (1976) and Pace (1979) on OECD countries; Brodsky and Sampson (1979) and Yeats (1976) on Latin America and Asia; and, more recently, Amjadi and Yeats (1995), Amjadi, Reincke, and Yeats (1996), and UNCTAD (1995) on sub-Saharan Africa. These studies document differences in shipping costs but do not directly estimate the relationship between shipping costs and manufactured exports or economic growth.

costs have had faster manufactured export growth and overall economic growth during the past thirty years than country's with higher shipping costs. The evidence suggests that high-shipping cost countries will find it more difficult to promote export-led development, even if they reduce tariff rates, remove quantitative restrictions, and follow prudent macroeconomic policies. At a minimum, firms in such countries would be forced to pay lower wages to compensate for higher transport costs in order to be able to compete on world markets for manufactures. The required offset in wages might be quite substantial in the usual case for developing countries in which imported inputs constitute a high proportion of the value of exports. In such sectors, high transport costs can easily wipe out export profitability even if wage levels were to fall to zero. As a result, geographically remote countries such as Mongolia, Rwanda, Burundi, Bolivia may not realistically be able to replicate the East Asian model of rapid growth based on the export of labor-intensive manufactures.

Casual observation suggests that Smith's observation of a strong tie between access to the sea and manufactured trade holds true today. Table 1 shows the top 15 developing country performers between 1965-90 in terms of annualized growth of non-primary-based manufactured exports (that is, excluding manufactured exports derived from natural resources, such as diamonds, plywood, and mineral manufactures³), measured as a percent of GDP. For each year t , we calculate $(X_t - X_{t-1})/GDP_{t-1}$, where X is the level of manufactured exports in dollars, and GDP is total GDP in dollars. This measure of export growth, denoted GEXGDP is then averaged over the years 1965 to 1990. For each country, we also show the share of the population living within 100 kilometers of the sea coast, denoted as POP100km based on original calculations at HIID using Graphical Information Systems (GIS) data on world population.⁴ For our sample of 92 developing countries, the (unweighted) average proportion of the population near the coastline is 45 percent. We see that in all except one of the high-export-growth countries, the proportion of the population near the coast is much higher than the average. In fact, in most of the top fifteen exporters, nearly the entire population lives within the 100 km radius (often because the economy itself is a small island). Later in the paper we demonstrate that the link between POP100km and GEXGDP during 1965-90 is in fact large and statistically significant, even after controlling for other determinants of export growth. Notice that no landlocked countries are among the top fifteen exporters. Notice as well that almost all of the successful countries are located either directly on major shipping routes or are close to a major developed-country market (Tokyo, Western Europe, or the United States)

Our focus is on developing countries, which we define as countries with a PPP-adjusted GDP (in 1985 dollars) of \$5,000 or less in 1965, using the Penn World Tables Version 5.1. In any event, most OECD countries, with the exceptions of Australia and New Zealand, are located very close to their major markets -- the other developed countries -- so that transport costs are less of an issue. Our specific concern is with developing countries wishing to initiate labor-intensive export-led growth in manufactures, as in East Asia. Is this development strategy dependent on favorable geography? Is it limited to coastal economies close to the major

³ Specifically, we exclude SITC (Revision 1) 0-4, 61, 63, 66, 68, and 9.

⁴ The data were prepared by Andrew Mellinger, and are described in Mellinger (1998).

advanced-country markets?

We begin in the next section by examining some data on shipping costs, and exploring some factors that might account for differences in these costs across countries. The following section examines the relationships between shipping costs, wages, and competitiveness in international trade. We then proceed to explore directly the possible relationships between shipping costs and long-run economic growth. The final section discusses some other considerations and caveats. We observe, for example, that transport costs are tending to fall over time, that air shipment provides a viable alternative for at least some production processes, and that some aspects of shipping costs (customs clearance, ports fees) are very much under the control of policymakers.

Some Determinants of Shipping Costs

Consider the costs of imports. The FOB (free on board) price measures the cost of an imported item at the point of shipment by the exporter, specifically as it is loaded on to a carrier for transport. The CIF (cost-insurance-freight) price measures the cost of the imported item at the point of entry into the importing country, inclusive of the costs of transport, including insurance, handling, and shipping costs, but not including customs charges. The CIF/FOB band, which is our basic measure of shipping costs (SC) is defined as $SC = (CIF/FOB) - 1$. We measure shipping costs for each country from the point of view of the country's imports, because that is how the data are generally available, though obviously shipping costs apply both in the direction of imports and exports. Notice that SC will depend not only on the charges for shipping a standardized type of freight (e.g. a twenty foot equivalent container) but also on the composition of trade. For very high value added commodities per unit weight (e.g. precious metals) will have very low CIF/FOB markups. The costs of shipping agricultural exports, similarly, will differ depending on whether they are perishable or dry bulk and the extent to which they have been processed (e.g., groundnuts vs. groundnut oil). Metals and minerals will also differ, depending on the specific commodity, for example whether the cargo is liquid (e.g., LNG, petroleum) or solid, etc. Thus, countries will differ in their average CIF/FOB ratios not only because of true differences in shipping costs for a given composition of goods, but also because of differences in the commodity mix. We hope that since the import basket of developing countries is more homogeneous than the export mix, the measure of the CIF/FOB ratio will reveal true differences in shipping costs rather than commodity mix effects.

In the empirical work below, we use the CIF/FOB ratios published by the IMF (IFS Yearbook, 1995), and shown in Table 2. These figures, of course, are not a perfectly accurate measure of actual CIF/FOB ratios, since they are in many cases estimated by IMF staff based on incomplete information. For most countries, they show little variance over time, indicating that IMF staff retain a constant CIF/FOB conversion factor once it is established for a country, and revise it only infrequently. Nevertheless, these data are relatively consistent and complete, and provide a good starting point for examining the general costs of international shipping for almost all countries in the world. Surprisingly, more direct shipping cost data — e.g. from transport companies — is generally proprietary information and therefore hard to assemble for a large number of countries on a systematic basis. We also examined data on shipping costs to the

United States, based on detailed US Department of Commerce data on imports from each country in the world recorded on both a CIF and FOB basis (as compiled by Feenstra, et al, 1997). Although this data provides very accurate information on shipping costs to the US, it is not indicative of general shipping costs, since the US is not the major market for many countries. We were unsuccessful in finding similar import data bases (where data is recorded in both CIF and FOB terms) for Japan or major European countries.

Shipping costs as measured by the CIF/FOB ratios are likely to differ across countries for several reasons. First, and most obviously, countries that are located further from major markets are likely to face higher shipping costs than proximate countries. Second, overland transport costs tend to be considerably higher than sea freight costs. Thus, for a given distance from main markets, countries with a higher proportion of transit by land will tend to have higher overall shipping costs. Third, there are extra costs to inter-modal transport (e.g. in which freight must be shipped both by land and sea), because of the extra costs of transferring between transport modes. Fourth, shipping costs differ because of differences in the quality of ports administration and/or ports infrastructure. Countries with better functioning ports authorities, less red tape for traders to work through, and more transparent and less corrupt customs clearance are likely to have lower overall shipping costs. Variations in basic port and handling fees can differ widely across countries. Similarly, countries with adequate port capacity, stronger ports infrastructure, and more sophisticated packaging and loading technologies are likely to have lower shipping costs.

Landlocked countries tend to face enormous cost disadvantages. They must pay the high costs of overland transport from the neighboring ports. These costs are increased by the bureaucratic and often political costs of crossing at least one additional international border. Infrastructure linking the inland economy with the port may be very poor, since there is a need for coordinating infrastructure investments in roads, customs houses, and so forth, between the landlocked country and the port country. The roads linking the landlocked country with the port may be poorly policed and maintained. Often the coastal economy has no interest in supporting economic development in the landlocked country (and may even have an interest in hindering development), for geo-strategic reasons. All of these risks probably add to insurance costs, as well as to basic shipment costs. The only alternative for landlocked countries is to ship by air, which is prohibitively expensive for most goods other than those with the very highest value per unit weight.

The extra shipping costs for six landlocked African countries are shown in Table 3. These data, which are drawn from UNCTAD, show the cost of exporting general cargo from several African countries to destinations in Northern Europe, East Asia, and North America. The data include sea shipment costs for all countries, plus the additional road or rail costs for landlocked countries. Landlocked countries pay between 25% (Malawi, shipping by rail through Tanzania) and 228% (Burundi, shipping by road through Tanzania) more for similar export shipments to Northern Europe than their coastal neighbors, even though the overland distances are a small proportion of the total transport distances. The CIF/FOB data reinforce the conclusions drawn from the UNCTAD African data on the extra shipping costs for landlocked countries. For the 97 developing countries in our sample, the mean CIF/FOB band in 1965 (the beginning of the time period under review) was 12.9%. For the 80 coastal economies, the average was 11.8%, while

for the 17 fully landlocked countries the average was 17.8%. *Thus, the cost of freight and insurance for landlocked developing countries was, on average, 50% higher than for coastal economies.*

Results from a simple regression analysis of CIF/FOB ratios are consistent with the basic ideas about the underlying determinants of shipping costs, including geography and port efficiency. As our measure of proximity to major world markets, we use the logarithm of the sea distance from each country to *nearest* major industrial country market. Specifically, we look at the minimum distance of the country to one of four major ports: Rotterdam, New York, Los Angeles, or Tokyo. (In further work, we will explore taking weighted average distances, based on the shares of trade with the various markets). The basic specification is:

$$\ln SC_i = \alpha_0 + \alpha_1 \ln DIST_i + \alpha_2 LANDLOCK_i + \alpha_3 \ln GDP_i + v_i$$

where SC_i is the shipping cost in country i (as measured by the CIF/FOB band), $DIST$ is the sea distance to the nearest major world market, $LANDLOCK$ is a dummy variable (=1) for landlocked countries, and GDP is PPP-adjusted gross domestic product in 1965 (in 1985 dollars). According to the regression estimates in Table 4, each 10% increase in sea distance is associated with a 1.3% increase in shipping costs. For a country with the mean shipping distance (1,900 miles) and income levels in our sample, an extra 1,000 miles of sea distance tends to increase the CIF/FOB band by about 0.6 percentage points. In addition, as expected, the results strongly confirm that landlocked countries pay more for freight and insurance.⁵ At the means for the other variables, a landlocked country pays about 5.6 percentage points more for shipping than a coastal economy (i.e., an increase in the CIF/FOB band from 8.9% to 14.5%). This represents an increase of 63% in freight and insurance costs for landlocked countries, after controlling for the other variables. The difference is statistically significant.

With respect to the quality of ports administration and infrastructure, comparable data on port quality are available for only a small number of countries, so in our base regression, we use as a proxy the log of 1965 GDP per person, measured in constant purchasing power parity prices (Penn World Tables, 1995). Generally speaking, higher income countries are likely to have better ports infrastructure and more efficient ports administration than lower income countries. The results show that countries with higher average income in 1965 indeed had significantly lower shipping costs. Each 10% increase in average income is associated with 0.29% lower freight costs as measured by the CIF/FOB ratio. For a country with the mean shipping distance and income levels in our sample, an increase in GDP per capita of PPP\$500 is associated with a decrease of about 0.5 percentage points in the CIF/FOB band. Note that these three variables

⁵ Note that for the purposes of this analysis, since we are analyzing the extra shipping cost of countries that are isolated from major markets, we do not count Austria and Switzerland among the group of landlocked countries. Although they are landlocked, they sit in the midst of the European market, and are thus not economically isolated in the same sense as other landlocked countries. The cif/fob bands for Austria and Switzerland are 1.8% and 4.1%, amongst the lowest in the world.

alone capture 67% of the variance in CIF/FOB bands across countries, and each of the estimated coefficients is significant at the 5% level or lower.

In column 2, we show the results for a smaller sample of countries, using a more direct indicator of port quality. This measure is based on business surveys of perceptions of port quality, taken from the 1997 World Competitiveness Report (World Economic Forum, 1997). Each country is given a score between 0 (worst) and 1 (best). The results, while weaker than those in column 1, are broadly consistent with the idea that higher quality ports are associated with lower shipping costs. The landlocked variable loses its significance because the port quality variable is available for only four landlocked countries, two of which are Switzerland and Austria.

Shipping Costs and Manufactured Exports

The most important consequence of high shipping costs for developing countries are the detrimental impact on firms' competitiveness in international markets. For small countries that exert little impact on world prices, the higher the shipping costs, the more that firms will have to pay for imported intermediate goods, and the less they will receive for their exports. More specifically, if a country faces a perfectly elastic supply of imports or a perfectly elastic demand for its exports (approximately the case for most developing-country manufactured exports), changes in shipping costs will be translated one-for-one into changes in domestic prices. In competitive global markets, higher transport costs would have to be offset either by lower wages or by reduced costs somewhere else in the production process to allow firms to compete. In most labor-intensive manufactured export activities, where profit margins are thin, and imported inputs constitute a high proportion of total output value, small differences in shipping costs can spell the difference between profitability and loss in exports.

To illustrate, consider firms located in export processing zones (EPZs), which serve as a good example since nearly all of the output of these firms is exported. Table 5 lists the employment in EPZs by country in 1986, according to a study by the World Bank (World Bank, 1992). The countries are ranked by our estimate of the share of the total working age population employed in EPZs. Note that virtually all large EPZs are located in coastal economies, near good port facilities, and close to markets in the U.S., Japan, or Europe. This fact, in and of itself, is suggestive of the importance of transport costs for firms locating in EPZs. Each of these EPZs are in countries with a very high share of its population living near the coast (as shown in the last column of Table 5), with the exception of Mexico, which is located immediately next to the large US market.

Firms in EPZs almost exclusively export labor-intensive manufactured goods, especially textiles, garments and apparel, footwear, and electronics products. They rely heavily on imported intermediate goods, especially during the early years of production, with value added typically a relatively low share of output value. Table 6 shows that for firms in EPZs in East Asia, imported inputs typically accounted for about 60% of the value of output. (These shares typically decline over time as domestic firms begin to compete with offshore suppliers in producing intermediate goods.) Domestic intermediate inputs account for another 10% of the value of output, with value

added in the EPZ enterprise itself generally around 30%. The precise coefficients vary by sector, as shown by firms in Malaysian EPZs in the early 1980s. Electronics firms imported 78% of the value of output, with textile firms importing around 49%. This suggests that the penalty for higher shipping costs would be especially burdensome for electronics exporters.

A simple numerical example makes the point. Consider a prototypical firm producing labor intensive manufactured exports from a coastal location, shown in column 1 of Table 7. Following the data described above, CIF imports, domestic inputs, and value added account for 60%, 10%, and 30% of the value of FOB output. Suppose that initially this firm faces a CIF/FOB ratio of 12% both for imports and exports, and that the demand for its exports and its supply of imported inputs is perfectly elastic. If this firm were to move to a landlocked country, all of the extra shipping costs would have to be absorbed by lower domestic value added (assuming, for simplicity, that other domestic intermediate input prices remain unchanged). As shown in column 2, an increase in shipping costs of just 6 percentage points, with the CIF/FOB ratio rising to 18%, would wipe off one-third of domestic value added. Assuming that value added is substantially wage costs, the wage itself would have to be reduced by around two-thirds in order to accommodate the rise in transport costs! Krugman (1997) has made a similar point concerning the high elasticity of wages with respect to transport costs in cases where the share of imported inputs in domestic output is high.

Under these circumstances, firms in landlocked countries would not necessarily be precluded from competing on world markets, but they would almost certainly have to pay substantially lower wages. For some production processes with a lower import content, such as textiles, shipping costs would have less impact. Zimbabwe, for example, has had some success in manufacturing textiles for export to markets in Southern Africa. By contrast, for production processes with a high import content, such as electronics, shipping costs can reduce potential value added dramatically. Columns 3 and 4 of Table 7 show that for a typical landlocked country (with a CIF/FOB band of 18%), value added in electronics would only be half the value added in a coastal economy. Under these circumstances, a CIF/FOB band of 24% would wipe out all the value added in electronics production. Five of the countries listed in Table 2 have a cif factor greater than 24%, as undoubtedly do many other countries for which data are not available.

Since shipping costs can have such a huge impact on value added and profitability in labor-intensive manufactured exports, it stands to reason that countries with higher freight and insurance costs would face great difficulty in promoting these activities. Countries with higher shipping costs would be less likely to attract foreign investment in export activities, and their domestic firms would tend to be less competitive on international markets. To test this idea, we examined a wide range of variables that might be closely associated with the average annual growth rate of non-primary manufactured exports. Since some countries can record a very high growth rate when the volume of exports is very small, we again measure the growth of manufactured exports relative to GDP in the previous year (as in Table 1). This analysis expands on the earlier results found in Radelet, Sachs, and Lee (1997).

In addition to geography, government policies influence manufactured exports. Low tariff rates, relatively few quotas, and the absence of barriers to foreign exchange transactions (i.e.

currency convertibility on the current account) are all likely to help firms become more competitive in international markets. Of particular importance is likely to be low tariff rates for intermediate inputs and raw materials, since, as we have seen, these can account for a high share of final output. We use the openness measure constructed by Sachs and Warner (1995), which is the fraction of years between 1965 and 1990 that the country was considered to be open to trade.⁶ Similarly, the quality of public-sector institutions and their relationship to the functioning of markets are likely to be important to exporters. To capture these policy dimensions, we use the index of institutional quality from Knack and Keefer (1995), which is based on data compiled in the International Country Risk Guide (1995).⁷ This index aims to measure the security of property and contractual rights, the efficiency of the government's intervention in markets, and the allocation of public goods.

In addition to government policies, economic structure is likely to affect manufactured exports. We know that export-GDP ratios are lower in larger economies, so we expect the export growth to GDP ratios similarly to be lower in larger economies. We measure market size by the log of the initial level of gross domestic product in 1965. In addition, greater natural resource abundance is likely to detract from manufactured exports. Countries with abundant natural resources are less apt to export manufactured products, as strong resource exports tend to appreciate the real exchange rate (the relative price of tradeable to non-tradeable goods), and thereby to reduce the profitability of exports of manufactures (other than resource-based manufactures). We measure natural resource abundance by the share of net exports of primary products (exports minus imports) in GDP, a variant of the measure initially used by Sachs and Warner (1995).

Geographical attributes other than those captured by the shipping cost variable may also affect manufactured exports. In particular, we include the ratio of a country's coastline distance (in km) to its total land area (in km²). Countries with a longer coastline are likely to have more ports, have a larger share of the population with relatively easy access to the sea, and have a larger share of economic activity grounded in international trade. In using this variable, we follow Adam Smith, who stressed the importance of England's long coastline for its sea-based trade. "England, on account of the natural fertility of the soil, *of the great extent of the sea-coast in proportion to that of the whole country*, and of the many navigable rivers which run through it, and afford the conveniency of water carriage to some of the most inland parts of it, is perhaps as well fitted by nature as any large country in Europe, to be the seat of foreign commerce, of manufactures for distant sale, and of all of the improvements which these can occasion." (Emphasis added). An alternative, and similar measure, is the proportion of the population living relatively near the sea. A larger share of the population living near the sea would tend to raise

⁶ A country is considered to be open if it meets minimum criteria on four aspects of trade policy: (i) average tariff rates, (ii) extent of imports governed by quotas and licensing, (iii) average export taxes, and (iv) the size of the black market premium on the exchange rate.

⁷ The overall index is itself an average of five indicators of the quality of public institutions, including: (i) the perceived efficiency of the government bureaucracy; (ii) the extent of governmental corruption; (iii) efficacy of the rule of law; (iv) the presence or absence of expropriation risk; and (v) the perceived risk of repudiation of contracts by the government.

the proportion of trade in the economy for any given CIF/FOB shipping costs. As in Table 1, the particular measure we use is the share of the population living within 100 kilometers of the sea in 1995, as calculated by Mellinger, using GIS-based data on the global population.

We examined the relationship between these variables and the annual weighted growth rate of non-primary manufactured exports for 43 developing countries between 1965 and 1990. The basic form of the regression is:

$$GEXGDP_i = \beta_0 + \beta_1 OPEN_i + \beta_2 INST_i + \beta_3 \ln GDP_i + \beta_4 NR_i + \beta_5 COAST_i + \beta_6 \ln SC_i + \omega_i$$

where GEXGDP is the annual average growth of exports as a share of GDP, OPEN is the Sachs-Warner openness index, INST is institutional quality, NR is net natural resource exports as a share of GDP, COAST is the ratio of coastline to land area, and SC is shipping costs. In our estimates, we use a base-year (1965) measure of the CIF/FOB ratio, to ensure that any observed link between shipping costs and export growth is a result of the effect of shipping costs on exports, rather than a result of export growth on reduced shipping costs. In the estimates we exclude Singapore, Hong Kong and Korea from the sample since their growth rates were such large outliers from the rest of the sample (in addition, data for Taiwan are not available). However, the basic conclusions hold with even greater force for these countries.

The results are shown in Table 8. Countries with more open trading systems recorded an average growth rate for non-primary manufactured exports that was about 0.5 percentage points per year higher than for more closed economies, after controlling for other variables. The estimated coefficient is highly statistically significant and is robust to alternative specifications. The size of the coefficient is relatively large, since it is approximately equal to the average growth rate of non-primary manufactured exports (as a share of GDP) for the sample. Similarly, institutional quality has a strong and positive relationship with exports. Each one point increase in this index (on a scale of 1-10) is associated with a 0.13 percentage point increase in the dependent variable. The size of the domestic economy has the expected negative relationship with manufactured export growth, but the estimated coefficient is not significant at standard levels. Column 3 shows the results when this variable is excluded. Natural resource abundance is also negatively correlated with non-primary manufactured exports. Each ten percentage point increase in the share of net primary product exports is associated with a 0.174 percentage point increase in the export growth rate. Natural-resource-abundant countries, in general, have much lower growth in manufactured exports. Of course, there are some exceptions, such as Malaysia, which recorded one of the fastest growth rates in the world for non-primary manufactured exports during the period.

As expected, geographical attributes strongly influence the growth of manufactured exports. The longer a country's coastline relative to its area, the higher is the growth of manufactured exports. Using the alternative measure of the share of the population living within 100 km of the coast, the results are even stronger. One possible problem with this variable is that the causality could run the other way, from exports to coast population, through internal

migration, since the variable is measured in 1995. To control for this possibility, we also estimated the relationship with instrumental variables, using the proportion of the land area within 100 km of the coast as an instrument for the proportion of the population within 100 km of the coast. The IV estimate confirms the importance of the coastal share as a cause, rather than effect, of manufactured exports.

The results also show a close link between shipping costs and growth of non-primary manufactured exports. In this case, we use the 1965 CIF/FOB band, to eliminate the possibility that rapid export growth led to reduced shipping costs. We estimated the relationship using alternatively the CIF/FOB band and the log of the CIF/FOB band, and obtained somewhat stronger results with the latter. The estimated coefficient is significant at the 1% level, and is fairly robust across different specifications. The estimated coefficient of about -0.5 implies that an increase in the cif band from 12% to 17% would reduce the long-term annual growth rate of non-primary manufactured exports by about 0.2 percentage points of GDP.

Transport Costs and Economic Growth

Shipping costs are also likely to affect a country's long-run rate of economic growth. There are several channels through which shipping costs could affect growth. First, as we have seen, is the relationship between shipping costs and manufactured exports. Radelet, Sachs and Lee (1997) observed that the countries that have been most successful in promoting non-primary manufactured exports have generally been the same countries that have recorded the fastest rates of economic growth during the past thirty years, with very few exceptions. To the extent that exports are crucial for earning the foreign exchange to purchase imported capital goods necessary for growth, successful export performance and overall economic growth will be closely linked. (See Sachs, 1997, for a simple model of this effect). Second, for exporters of primary products, higher shipping costs would reduce the rents earned from natural resources, thereby possibly lowering aggregate saving rates and investment. Third, higher shipping costs would raise the price of all imported capital goods, which would tend to reduce real investment and slow the process of technology transfer through capital imports.

To test the linkages of shipping costs and aggregate growth, we estimated the relationship between economic growth and a wide range of variables, including shipping costs, for a group of 64 developing countries between 1965 and 1990 (this is the sub-sample of countries for which the relevant data could be assembled). The framework is an extension of the cross-country growth analysis pioneered by Barro. Specifically, we build on the results in Radelet, Sachs and Lee (1997), which did not directly consider the impact of shipping costs. A full description of the model and the data set, estimation results for a wide set of possible explanatory variables, and a broad discussion the use of neoclassical growth models for this approach are contained in the previous paper and need not be repeated in detail here. To summarize, four broad sets of variables appear to be most closely associated with economic growth across countries between 1965-90: initial conditions (income level, health, and education), government policies, demographic characteristics, and geographic and resource endowments (including shipping costs). The eleven specific variables we include account for a very satisfactory 83 percent of the variance in growth

rates across countries. The results are in Table 9. (For a complete discussion of the non-shipping cost variables, see Radelet, Sachs, and Lee, 1997).

We find a strong relationship between shipping costs and economic growth, after controlling for the ten other variables. The estimated coefficient is highly significant, and remains so across alternative specifications. The results imply that doubling shipping costs (e.g., from an 8% to 16% cif band) is associated with slower annual growth of slightly more than one-half of one percentage point. All else being equal, a landlocked country with shipping costs 50% higher than a similar coastal economy could expect slower growth of about 0.3 percentage points per year. Column 2 shows the results excluding the demographic variables, and column 3 includes regional dummy variables, with little impact on the estimated shipping cost variable. Column 4 shows the results when limiting the sample to the countries included in the earlier regressions on non-primary manufactured exports, for which complete data are available. The estimated coefficient for the shipping variable is larger for this set of countries, and remains highly statistically significant.

Additional Considerations and Concluding Observations

Shipping costs are undoubtedly falling over time for all countries as improved technologies reduce port time and speed sea travel. Unfortunately, this trend is not evident in the IMF's published CIF/FOB bands, which do not show a significant time trend. This is most likely due to the IMF's tendency to update these estimates only infrequently. By contrast, the implicit CIF/FOB band from the US Department of Commerce import data show a significant downward trend over time. Containerization and the resulting ease of moving goods from ship to truck or rail, for example, have reduced port costs and loading time. Shipping costs are much less of a barrier to international trade and a greater division of labor than they once were. There are reasons to believe that these costs will continue to fall in the future. Moreover, for some activities, shipping costs are much less of an issue than for others. For relatively lightweight goods per unit value, air shipment can be a viable alternative for landlocked countries, reducing the importance of goods ports and coastal location. For some services, the costs of telecommunications is far more important than the costs of shipment of goods. Data entry operations are increasingly carried out in remote locations with little more than a satellite hookup and reliable phone lines.

In addition, as we have noted, shipping costs are not completely exogenous, as they can be influenced by government policies. The quality of ports, roads, and rail infrastructure is likely to influence shipping costs. Moreover, ports fees, ease of customs clearance, and the extent of bureaucratic red tape involved in shipping all add to shipping costs, and in some cases probably rival the costs of sea shipment itself. For example, one World Bank study noted that port charges for clearing a 20-foot container in Cote d'Ivoire and Senegal were \$1,100 and \$910, respectively, compared to ocean freight costs to Europe of around \$1400 (Amjadi, Reincke, and Yeats, 1996). For landlocked countries, simply the costs associated with crossing an additional border, rather than distance or travel costs themselves, possibly add substantial amounts to transport costs. Thus, governments, working either alone or in cooperation with their neighbors, can take steps to

reduce the burden of transport costs on local firms.

The basic conclusion of this analysis is that geographic isolation and higher shipping costs may make it much more difficult if not impossible for relatively isolated developing countries to succeed in promoting manufactured exports. Firms from such countries will likely have to pay lower wages to workers and accept smaller returns on capital to compensate for higher shipping costs. For some production processes with a high import content and small profit margins, such as electronics, high shipping costs can essentially eliminate more remote countries from international competition. For countries with higher shipping costs, it becomes all the more important to get basic macroeconomic and trade policies right, to cut red tape in ports operations, and to expedite customs clearance. Even under these circumstances, countries in remote locations will find it much harder to succeed in promoting labor-intensive manufactured exports than other countries with more favorable locations.

**Table 1. Developing Country Exporters of Non-Primary Manufactured Products
Top 15 performers, 1965-90**

Country	Non-primary Manufactured Export Growth*	Share of Population living within 100 km of Coast
Singapore	11.6	100
Hong Kong	7.14	100
Korea	4.40	94
Malaysia	2.30	88
Mauritius	2.22	100
Dominica	2.04	100
Bahamas	1.42	100
Israel	1.38	98
Cyprus	1.38	98
Tunisia	1.31	84
Jamaica	1.30	100
Thailand	1.21	37
Barbados	1.13	100
Dominican Republic	1.07	100
Haiti	0.93	100

* Average annual growth rate of non-primary manufactured exports as a share of GDP

Table 2. CIF/FOB Band, 1965-1990 average (%)

Country	CIF/FOB Band	Country	CIF/FOB Band
Algeria	10.0	Myanmar (Burma)	10.1
Australia	10.3	Netherlands	5.6
Austria	4.1	New Zealand	11.5
Bangladesh	11.8	Niger	19.5
Burkina Faso	26.6	Norway	2.7
Cameroon	9.7	Pakistan	9.5
Canada	2.7	Papua New Guinea	13.3
Chad	33.6	Philippines	7.6
Cyprus	10.5	Portugal	10.3
Denmark	4.5	Rwanda	40.6
Finland	4.8	Senegal	13.9
France	4.2	Sierra Leone	12.0
Gambia	16.7	Singapore	6.1
Germany, West	3.0	South Africa	8.3
Ghana	7.8	Spain	6.4
Greece	13.0	Sri Lanka	11.1
Guinea-Bissau	14.8	Sweden	3.5
Guyana	10.1	Switzerland	1.8
Haiti	15.5	Syria	8.5
India	12.1	Tanzania	16.8
Ireland	5.0	Thailand	11.0
Israel	7.6	Togo	19.3
Italy	7.1	Trinidad & Tobago	9.5
Jamaica	15.3	Tunisia	6.7
Japan	9.0	Uganda	10.9
Jordan	12.3	United Kingdom	6.0
Kenya	15.8	United States	4.9
Malawi	33.5	Venezuela	11.3
Malaysia	10.5	Zambia	18.1
Mali	41.7	Zimbabwe	11.2
Mexico	4.8		

Table 3. Transport Costs, Coastal and Landlocked Countries in Africa

Based on export shipments in 1995, US dollars, per twenty-foot equivalent (TEU)

<i>Coastal Country</i>	<i>Inland route</i>	<i>Landlocked Country</i>	<i>Destination</i>		
			Northern Europe	Japan	North America
Senegal			1,610	4,100	n.a.
	via Senegal:	Mali	2,380	4,870	n.a.
		additional cost (%)	48%	19%	
Ghana			1,815	3,025	2,460
	via Ghana:	Burkina Faso	2,615	3,825	3,260
		additional cost (%)	44%	26%	33%
Cameroon			1,520	n.a.	n.a.
	via Cameroon:	Central African Rep.	2,560	n.a.	n.a.
		additional cost (%)	68%		
Tanzania			1,380	1,350	2,000
	via Tanzania by road:	Rwanda	3,880	3,850	4,500
		additional cost (%)	181%	185%	125%
		Burundi	4,530	4,500	5,150
		additional cost (%)	228%	233%	158%
		Zambia	3,250	3,220	3,870
		additional cost (%)	136%	139%	94%
		Malawi	3,090	3,060	3,710
		additional cost (%)	124%	127%	86%
	via Tanzania by rail:	Zambia	2,380	2,350	3,000
		additional cost (%)	72%	74%	50%
		Malawi	1,730	1,700	2,350
		additional cost (%)	25%	26%	18%

Source: UNCTAD "Review of Maritime Transport 1995"

Table 4. Determinants of Shipping Costs

Dependent Variable: Shipping Cost (CIF/FOB band, log), 1965-1990 average

Independent Variable	Coefficients (t-statistics)	
	I	II
Shipping Distance (log)	0.13 (2.25)	0.21 (3.17)
Landlocked	0.43 (2.96)	0.19 (0.60)
GDP per capita (1965, log)	-0.30 (-4.38)	
Port Quality		-0.09 (-1.36)
Number of Countries	61	31
Adjusted R²	0.67	0.41

Note: Constant term not reported.

Table 5. Employment in Export Processing Zones

Country	EPZ Employment, 1986, share of working age population	EPZ Employment, 1986, thousands	Share of population living within 100 km of coast
Singapore	11.9	217.0	100
Mauritius	9.5	61.7	100
Hong Kong	2.4	89.0	100
Dominican Republic	1.0	36.0	100
El Salvador	1.0	25.0	99
Tunisia	1.0	40.0	84
Malaysia	0.9	81.7	88
Taiwan	0.6	80.5	100
Jamaica	0.6	8.0	100
Mexico	0.6	250.0	26.5
Korea	0.5	140.0	94
Trinidad and Tobago	0.4	2.7	100
Sri Lanka	0.4	35.0	95
Panama	0.2	2.1	100
Haiti	0.2	5.0	100

Note: other countries with 1986 EPZ employment, in order of share of the working age population, are: United Arab Emirates, Philippines, Honduras, Brazil, Ghana, Colombia, Senegal, Chile, Thailand, Indonesia, Bangladesh, India, and Pakistan.

Table 6. Export Processing Zones: Imports, Exports, and Value Added

	Imports/ Output (%)	Value Added/ Output (%)	Wages/ Output (%)
Indonesia (1978-82)	61	n.a.	n.a.
Malaysia (1975-82)	66	n.a.	8
Korea (1972-78)	54	30	n.a.
Philippines (1975-82)	61	31	14
Malaysian electronics (1982)	78	21	8
Malaysian textiles (1982)	49	13	9

Source: Warr (1984, 1987, 1989)

Table 7. Shipping Costs and Manufactured Exports: An Example

	Labor Intensive Exports		Electronics Exports	
	Coastal Economy	Landlocked Economy	Coastal Economy	Landlocked Economy
Imports (fob)	53.6	53.6	69.6	69.6
Sea freight (12%)	6.4	6.4	8.4	8.4
Inland transport (6%)	...	3.2	...	4.2
Imports (cif)	60.0	63.2	78.0	82.2
Local inputs	10.0	10.0	2.0	2.0
Value added	30.0	21.1	20.0	10.2
Export sales price	100.0	94.3	100.0	94.3
Inland transport (6%)	...	5.7	...	5.7
World price	100.0	100.0	100.0	100.0

Table 8. Manufactured Export Growth Regressions

Dependent Variable: Average annual growth rate of non-primary manufactured exports as a share of previous year GDP.

Sample: 43 developing countries

Independent Variable	Coefficients (t-statistics)			
	I	II	III	IV
Openness	0.47 (2.57)	0.53 (3.14)	0.48 (2.56)	0.52 (2.95)
Quality of Institutions	0.13 (2.69)	0.11 (2.53)	0.11 (2.42)	0.11 (2.48)
Gross Domestic Product (1965, log)	-0.06 (-1.49)	-0.05 (-1.32)		-0.05 (-1.31)
Natural Resource Abundance	-1.74 (-1.94)	-2.12 (-2.58)	-1.45 (-1.63)	-2.13 (-2.55)
Coast/Land Area	0.51 (2.13)		0.50 (2.07)	
Share of Population near coast		0.59 (3.47)		0.58 (3.10)
Shipping Cost (1965 CIF/FOB band, log)	-0.60 (-3.72)	-0.40 (-2.51)	-0.55 (-3.42)	-0.41 (-2.48)
Primary Schooling Ratio (1965, log)				0.03 (0.19)
Adjusted R²	0.46	0.54	0.44	0.53

Note: Constant terms not reported.

Table 9. Cross Country Growth Regressions

Dependent Variable: Growth of real per capita GDP, 1965-90

Sample: Developing Countries

Independent Variable	Coefficients (t-statistics)			
	I	II	III	IV
Initial GDP per capita (1965, log)	-1.73 (-7.00)	-1.87 (-7.86)	-1.84 (-6.21)	-1.74 (-4.94)
Life Expectancy (1965, log)	3.46 (2.65)	4.42 (3.99)	3.39 (2.60)	4.25 (2.76)
Primary Schooling Ratio (1965, log)	0.62 (2.08)	0.65 (2.14)	0.60 (2.02)	0.52 (1.09)
Openness	2.12 (5.25)	2.32 (5.87)	1.97 (4.62)	2.18 (4.70)
Government Savings Rate	0.14 (4.97)	0.14 (4.98)	0.14 (4.94)	0.17 (3.68)
Quality of Institutions	0.30 (3.35)	0.33 (3.80)	0.37 (3.43)	0.28 (2.46)
Growth of Working Age Population	0.80 (1.81)		0.45 (0.86)	
Growth of Total Population	-0.68 (-1.53)		-0.36 (-0.66)	
Natural Resource Abundance	-5.06 (-4.09)	-5.01 (-4.06)	-4.62 (-3.66)	-8.24 (-2.85)
Tropics	-0.81 (-2.60)	-0.80 (-2.52)	-0.52 (-1.44)	-0.41 (-0.97)
Shipping Cost (CIF/FOB band, log)	-0.81 (-2.76)	-0.89 (-3.06)	-0.76 (-2.54)	-1.28 (-3.34)
Asia			-0.44 (-0.92)	
Latin America			-0.53 (-1.12)	
Sub-Saharan Africa			-1.01 (-1.82)	
Number of Countries	64	64	64	41
Adjusted R ²	0.83	0.82	0.83	0.73

Note: Constant term not reported.