

# Logistics, Transport and Food Prices in LAC:

Policy Guidance for Improving Efficiency  
and Reducing Costs



Second Meeting of the Finance Ministers of the Americas and the Caribbean

Viña del Mar, Chile - July 3<sup>rd</sup>, 2009



THE WORLD BANK





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This policy discussion paper is the result of a joint Inter-American Development Bank and World Bank effort to provide background information on issues of particular interest to the Finance Ministers of Latin America and the Caribbean Region.

Santiago Levy, Vice-President for Sectors and Knowledge at the Inter-American Development Bank and Augusto de la Torre, Chief Economist for Latin America and the Caribbean at the World Bank provided quality assurance and overall direction to the process.

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The opinions expressed in this paper are those of the authors and do not necessarily represent the views of the Inter-American Development Bank or of the World Bank.

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## **Abbreviations and Acronyms**

BTI	International Trade Database
CARICOM	Caribbean Community
CIF	Cost, Insurance and Freight
ECLAC	Economic Commission for Latin America and the Caribbean
FAS	Free Alongside
FOB	Free on Board
GDP	Gross Domestic Product
LAC	Latin America and the Caribbean
LPI	Logistics Perceptions Index
OECD	Organisation of Economic Cooperation and Development
OECS	Organisation of Eastern Caribbean S
TEU	Twenty-foot Equivalent Unit
UN	United Nations
WDI	World Development Indicators

## EXECUTIVE SUMMARY

### Coming to Terms with Logistics Costs

Transport and logistics costs are high in the LAC region. On a macro-level, the World Bank has estimated LAC logistics costs as a percent of GDP as between 16 and 26 percent compared to the OECD benchmark of about 9 percent. At the national level, average logistics costs represent a share of product value between 18 and 32 percent, compared again with 9 percent for the OECD.

These costs represent a greater barrier to trade than import tariffs and make up a larger part of the delivered cost of food products. In fact, while food import tariffs are heterogeneous across countries and food groups, on average, ad valorem rates have decreased in the region from 2005 to 2008 and currently range from 3 to 12 percent of product value. On the other hand, with respect to transport and logistics costs, the international maritime and road haulage components alone can total about 20 percent of the FOB value of goods if combined. By the time products are transferred, handled, stored and distributed domestically, the logistics component of the delivered good is often more than 50 percent of the final price to consumers.

Research conducted for this paper shows that the Caribbean, a net food importing sub-region that appears to have particularly high logistics costs, also has the highest import tariffs, punishing its consumers twice. In 2008, import tariffs across all food groups averaged about 16 percent for Caribbean countries, compared to 11 percent for Central American countries and 5 percent for South America. On a weighted average basis, import tariffs on all food groups have decreased with the exception of dairy, which have increased from 2006 to 2008. Such growth has been driven by the Caribbean countries (primarily Barbados, Dominica, and St. Vincent and the Grenadines) and by Mexico. This situation is particularly worrisome given that in addition to higher import tariffs, the shipping structures of the Caribbean islands provides for very little direct service and low connectivity, which research has shown leads to higher ocean freight rates. Regression analysis has shown that if a country can “double” its centrality within the global shipping network, transport costs would decrease by over 15 percent.

At a regional level, the impact of transport and logistics costs on the final price of food products becomes even more relevant when taking into consideration that in 2006, more than 71 million tons of food products with a value of over \$US21 billion were imported into the countries of South America and Mexico. Of this sum, a little over a third was comprised of intra-regional trade. The remainder, well over 50 million tons of food products, is imported per year into LAC from outside of the region. The majority of those food products arrives by ocean shipping and is thus subjected to every step of a logistics chain, including maritime transport, port transfers, customs clearance and inspection, warehousing, modal transfers, domestic rail, trucking and/or barge shipping and final distribution. These steps typically add 30 to 100 percent onto the price of delivered goods, and in exceptional cases—such as fruit imports to the Caribbean islands—may triple the cost of a product from the time it leaves its home of origin to the time it arrives at market.

There is great heterogeneity in the way in which LAC countries are impacted by these logistics and transport costs, depending on the relative shares of different types of food imports. An analysis of the breakdown in food types suggests that for net importers of food, costs associated with refrigerated cargo capacity and services are the critical bottlenecks, as meat, fish, and dairy represent the largest share of all food imports by value (26 percent). On the other hand, for LAC countries that are net exporters of food, bulk storage, handling and transporting are the primary concerns, as, on a weighted-average basis, dry bulk items constitute by far the biggest share of food imports at 31 percent by value. Thus, the data suggests that the island countries of the OECS, for example, should work on reducing the cost of refrigerated containerized traffic (herein referred to as “reefer”). Peru, Brazil, Bolivia and Colombia, on the other hand, would benefit from improvements in the importing and distribution process for dry bulk goods.

Regardless of the shifting prices of staple commodities in global markets, a large portion of foods by volume are low value goods and thus highly sensitive to international and domestic transport, warehousing and transfer costs. In fact, in recent years international and domestic shipping costs have risen and fallen along with commodity prices, leaving the impact of logistics costs on food prices relatively constant. In other words, the “burden” (share of freight rates as FOB cost for food) for both maritime and trucking elements of costs remained relatively constant as the delivered price of food rose. As ocean rates doubled from 2002 to 2007, the maritime burden fell

only by 1 percent. As trucking rates increased by 50 percent over the same period, the land burden rose by one half of percent.

Two supply chain analyses conducted for this study illustrate that transport and logistics costs can be punishing not only on low value goods- such as wheat, but also on high value goods, such as pineapples. The first analysis, tracking pineapple imports from Costa Rica to St. Lucia via Miami as a regional consolidation center, suggests that distance is not a central driver of costs and that a country's connectivity in the cost structure of its imports should be highlighted when tackling logistics and transportation costs. The analysis shows that the producer price of the pineapple itself represents only about 10 percent of the final delivered price, while transport costs related to land and ocean transportation and handling account for 43 percent. In addition, storage, warehousing, consolidation and the retail and wholesale profits together represent another 33 percent, half of which is also logistics. Ocean shipping represents a particularly large part of the transport costs: 3.5 times as much as the producer price for the pineapple itself. Yet, this is not a function of distance, as the ocean shipping leg from Miami to St. Lucia is an order of magnitude more costly than the leg from Costa Rica to Miami, although the trip to St. Lucia is shorter.

The second supply chain analysis, which tracks a kilogram of wheat from the time it leaves the Port of Vancouver, Canada until it arrives at the mills of Ecuador, confirms these conclusions, suggesting that distance, along with market size, is less likely to drive transport costs than infrastructure quality and competition among transport providers. The analysis shows that once the wheat cargo is unloaded in Ecuador, the cost of domestic transportation to Quito is minimal due mainly to the high degree of competition in the Quito market and the availability of good roads linking the coast and the capital city. However, when the price of wheat flour to other cities is assessed, domestic transportation costs are more significant. The delivered cost to a city such as Ambato further adds another 20 to 25 percent onto the cost of the product. The large price difference is mostly explained by the quality of the road infrastructure and the ability of trucks to make a return trip within a day when traveling to and from Quito. Additionally, the analysis suggests that the manner of transport does seem to matter if it can capture scale economies. The distance from Canada to Ecuador is many thousands of nautical kilometers while the distance from the port at Manta to the mill in Quevedo is only 171 kilometers. Yet, somehow, shipping a kilogram of wheat from Vancouver to



Manta costs less than half of the cost of trucking that same kilo of grain from Manta to Quevedo. If competing modes of transportation are available, agglomeration of cargo may mean economies of scale. This fact becomes important in discussing competition in domestic shipping.

### **Maritime Transport**

According to econometric modelling carried out for this paper, food prices are sensitive to maritime transport costs. The analysis suggests that ocean shipping rates do seem to affect the price of commodities; specifically corn, soybean and wheat are shown to be affected by maritime shipping costs. For each increase of 10 percent of the bulk shipping index, the estimated impact on commodity prices is in the order of 1.5 percent.

These costs, namely ocean shipping freight rates, and in turn, the delivered price of commodities, are affected by a variety of different factors, including port infrastructure endowment, efficiency levels, inter-port connectivity, degree of private sector participation, and competition among service providers. Increases in port infrastructure endowment and efficiency have resulted in faster turnaround times for vessels, faster cargo throughput, and quicker amortization of investment costs for port investors. Improvements in port efficiency have also reduced the costs incurred by cargo-owners and consignees, as delays, storage, warehousing, inventory, and demurrage charges can be avoided. With respect to the degree of competition among service providers, it has been shown that around two fifths of the variance of the freight rate can be explained by the number of carriers operating on the given route, and that the number of liner shipping companies providing direct services between pairs of countries has a stronger impact on the freight rate than does distance.

Another important factor influencing ocean shipping costs lies in the kinds and size of vessels calling a port. "Gearless vessels", those that do not need to have their own cranes, call ports that have sufficient equipment to load and unload the vessel efficiently. On the other hand, "geared vessels", or those ships that carry their own cranes on board, call smaller ports that cannot provide their own equipment. Not only do "geared vessels" experience a depreciation of equipment, but take up valuable space and use fuel and other costs (such as maintenance and operations) to be transported around the seas. In 2008, the charge per ton of containerized good was about 15 percent higher for the geared

vessels, assuming the same sizes. The size of the vessels calling each port, however, has an even greater impact on the cost per containerized cargo being shipped. In 2008, containerized cargo travelling on a 200-299 TEU capacity geared vessel paid more than twice as much on average as cargo travelling on a geared vessel of 1000 to 1299 TEUs. The difference has grown since 2001 as larger and more efficient vessels have entered the market.

### **Customs Clearance and Border Crossings**

Regression analysis conducted for this paper reveals that delays in customs clearance in LAC increase transport costs by between 4 and 12 percent. That is, if time for customs clearance could be halved, transport costs could be reduced by that same percentage. This finding is consistent with LAC firm perception surveys from Investment Climate Surveys, Doing Business Surveys and the Logistics Performance Index (LPI): in terms of customs efficiency and organization, the LPI's first dimension, LAC as a region in the 2007 survey received a score of only 2.5 out of 5.

Furthermore, the analysis of border crossing and customs to freight rates suggests that the existence of a direct land access of any type reduces transport costs by around 6 percent. Moreover, a doubling of the number of border crossings could reduce transport costs by another 6 percent. These border crossing burdens affect food prices given the importance of intra-regional trade in primary staples such as grains and beef. Regression analyses show that “over” costs from inefficiencies in the logistics chain, particularly at border crossings, represent around 20 percent of the total costs incurred in the import of Paraguayan soy beans into Brazil and beef into Chile.

### **Inland Transportation: Roads and Trucks**

Road transport is responsible for handling 38 percent of all food imports into South America in terms of value. It is also responsible for nearly all domestic movements and for a significant share of inputs to food exports – particularly in Central America and Mexico. Given this fact, the lack of road maintenance is emerging as the greatest threat to the affordable and reliable delivery of basic goods in LAC, even for the region’s more advanced economies, such as Brazil and Costa Rica. The possibility of addressing this problem through the alternative use of railroads is limited. In Argentina, for example, the railroad’s relative share in transporting cereals and oilseed to Rosario fell from 20 percent

in 1998 to 15 percent in 2004. It has been estimated that in the case of this particular traffic alone, rail participation could be increased from 30 percent, with a consequent saving in freight costs per ton.

Finally, the efficiency of a country's trucking sector plays a role in its overall import cost structure. Trucking regulation, in particular, presents a paradoxical problem for many governments: costly if they do, costly if they don't. Shippers argue that tougher rules and enforcement related to weight restrictions, overloading, truck quality and safety will immediately increase transport costs which will be passed on to consumers. While it is true that transport regulations lead to costs which can be estimated, it is also true that the lack of regulation and/or enforcement of trucking regulations creates costs, although these are indirect and take time to manifest themselves. Typically, smaller producers and local agriculture traders are the most heavily affected by dilapidated roads and failures in trucking regulation, while large shippers using the main highways and trade corridors between large cities and ports are less affected.

### **Warehousing, Storage, and Inventory Costs**

High inventory costs are an important logistics bottleneck for the region, in turn, driving up the cost of delivered products. For LAC businesses, the World Bank calculates that inventory costs equal 35 percent of GDP, compared to only 15 percent of GDP for businesses in the United States. This can be explained by the fact that, beyond the roads themselves, the storage networks of many of the region's countries are sub-standard, warehouses lack competition and effective instruments for financing inventories, and the rates of storage space rental are higher in LAC compared to other regions. Moreover, there is an increasing lack of sufficient warehousing capacity in the agricultural sector, which has been proven to be particularly costly for small shippers.

The need for additional storage capacity is also a consequence of the shortage of efficient intermodal transfer terminals. According to estimates, Brazil's warehousing shortage alone is currently about 40 million tons per year. If Brazil were to double its number of intermodal transfer terminals from the current 250, the total inventory and warehousing costs could be reduced by as much as US\$1 billion per year.

## Policy Guidance

While the costs of logistics services seem to lie in the hands of the private sector, LAC government actions and inactions have an important influence on the logistics burden. Following are some areas for potential action:

- ***Maritime Transport***
  - Focus on investments, operational efficiency and landside linkages for greater connectivity
  - Anticipate growth and invest in landside and waterside capacity
  - Introduce spatial planning into the notion of port location and expansion
  - Encourage consolidation or coordination of small private operators
  - Use competition authority to investigate vertical and horizontal integration issues
- ***Customs Clearance and Border Crossings***
  - Improve clearances/inspections through better cross-border collaboration and coordination between phytosanitary and customs services
  - Set export clearance times as the standard for import clearance times
  - Simplify customs declarations forms, procedures and clearance
  - Use risk-based selectivity process for inspections
  - Harmonize customs standards for sub-regions
  - Reduce fines for minor documentation errors
- ***Inland Transportation: Roads and Trucks***
  - Focus on speed and ease of travel, competition in service provision and access and capacity of transfer and storage facilities
  - Improve road quality, keeping in mind that the present value of maintaining a road regularly is an order of magnitude less than rehabilitating it once every ten years
  - Strengthen trucking regulations and enforcements
  - Facilitate the development of ample storage, warehousing, and transfer facilities
  - Strengthen logistics planning based upon more sophisticated freight flow modeling



## **1. Introduction**

This introductory section explains the rationale for the Guidance Note, reflecting on the relevance of food prices in LAC, their impact on the poor and the effect that logistics and transport costs have on those prices. Based upon that framework, the note provides an overview of the logistics and transport hurdles faced by importers and consumers in the region as food products move through the logistics chain. The final section of the report provides some policy guidance that could improve the efficiency of logistics systems in LAC and reduce the price of delivered foods.

### **1.1 Summary of Findings**

#### *Food Matters in LAC*

- Despite its image as a self-sustaining region in agricultural production, about one-third of the population of LAC lives in net food importing countries--and most of the region's net food exporting countries import a large and growing segment of their food as well. This trend is driven by trade liberalization, greater concentration in production, the "supermarketization" of food retail, and the globalization of consumption habits. The more food products travel, change modes of transportation and cross borders, the higher the impact of logistics costs on the final price of food. An analysis of the breakdown in food types suggests that, for net importers of food, refrigerated cargo capacity and services are the critical bottlenecks. For imports going to LAC countries that are net exporters of food, bulk storage, handling and transporting are the primary concerns.
- Food expenditures make up a large part of the disposable income of the region's poor. Across income levels in LAC, food is the primary purchase of households accounting for 20 to 30 percent of all expenditures, depending upon the country. The poor, however, may spend up to 70 percent of income on food.

#### *LAC Consumers Eat a High Cost of Logistics*

- Transport and logistics costs make up a large part of the delivered cost of food products in LAC. The international maritime and road haulage components alone can total about 20 percent of the FOB value of goods if combined. By the time products are transferred, handled, stored and distributed domestically, the logistics component of the delivered good is often more than 50 percent of the final price to

consumers. As with other imported goods to LAC, this is about twice the levels of OECS countries.

- There is tremendous heterogeneity in logistics burdens among LAC's sub-regions, different types of food products and different trading modalities. Nonetheless, a reduction of logistics costs from port efficiency gains, road haulage improvements, the expediting of customs clearance and border crossings, better inventory practices and increased capacity and competition in storage and warehousing could reduce logistics costs by 20 to 50 percent. This would mean a permanent reduction in the baseline cost of food products ranging from about 5 to 25 percent.
- The cost burden of moving food into and around LAC has been largely unaffected by the rise and decline of commodity prices. While commodity prices rose sharply over the last two years, freight rates (both ocean and road) as a share of the value of food products hardly changed. That is, the cost of logistics rises along with international price changes for major food indexes. While there is some endogeneity associated with transport and food prices, countries that can shift to more efficient forms of transport and logistics will lock in benefits regardless of commodity price trends and spot market fluctuations.
- While the cost of logistics services seems to lie in the hands of the private sector, LAC government actions and inactions have an important influence on the logistics burden. This influence is often indirect, but they can impact every step in the logistic change, from ocean shipping to domestic trucking to transfers, storage and warehousing. More directly, government can influence customs clearance and border crossings.
  - Ocean shipping costs of food are impacted by port efficiencies, port capacity cargo agglomeration and the level of connectivity and competition in the global liner shipping network<sup>1</sup>. Countries which have coherent port development strategies that link to inland networks, allow for cargo agglomeration, provide for fast turnaround of large vessels, and utilize anti-trust regulations to assure competition among carriers can benefit from faster services, economies of scale and lower prices in the shipping of their food products.

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<sup>1</sup> This refers to containerised cargoes that are transport by regular liner services.

- Customs clearance and border crossings also play an important role in facilitating or hampering the efficient and timely movement of food products. A large share of food products are perishable and time sensitive, meaning that delays are particularly costly to consumers.
- Both the cost of international road transport – which have been rising as a share of FOB prices of imported food – and domestic trucking movements are driven more by infrastructure quality and service competition than by distance. The prioritization of governments in maintaining their roads and encouraging competition in warehousing, transfer stations and in trucking services likewise has a significant impact on the prices of delivered foods.

## 1.2 Dependence on Food Imports in an Exporting Region

As a whole, the Latin America and the Caribbean Region (LAC) is a net food exporter and has the largest surplus in food trade across all regions of the world.<sup>2</sup> This fact, however, does not mean that LAC is free from concerns about the cost of food. Indeed, no country in the region eats everything it produces and, more importantly, no country produces everything it eats. Food trade into and within LAC remains important for the following reasons:

- Eleven countries in the LAC region – representing about one-third of the region’s population – are net food importers, including the Caribbean islands, El Salvador, Mexico and Venezuela;

**Definition of Terms**

**Logistics:** For the purposes of this paper, the term “Logistics” refers to the infrastructure, services and procedures required to physically move a product from place of origin to destination.

**Food Cargo Types:** In the analysis of the impact of transport and logistics costs, the types of shipment that are required for each type of food cargo are defining characteristics of the sector. The primary types of cargo transport types are:

- Bulk grains: wheat, rice, maize, oats, soy, sorghum. These products are shipped in bulk carriers and trucks. Liquid foods such as edible oils, frozen concentrated orange juice and wine are shipped in specialized liquid bulk carriers.
- Containerized foods: processed foods, coffee, cacao, sugar. These products are shipped in general cargo or specialized container (cellular) ships as well as by truck or rail. Products may be stripped at port and distributed by smaller vehicles
- Perishable foods and produce: meat, fish, dairy, fresh fruits and vegetables. These products are shipped by refrigerated or “reefer” container in container ships, truck and rail chassis which need energy supply to keep units refrigerated.

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<sup>2</sup> World Bank (2008) Rising Food Prices Latin America and Caribbean Position Paper



- All countries in LAC depend on food imports for a large portion of consumption and the cost of importing generally is high<sup>3</sup>;
- Trade liberalization, greater concentration in production, and changing consumption patterns have contributed to a reliance on a widening range of imported products;
- The rapid “supermarketization” of LAC’s food retail industry has brought global trade practices into the local food sales industry. Supermarkets now control 50 to 60 percent of the food retail sector in Latin America—a fivefold increase in only 10 years.<sup>4</sup>
- Nearly 80 percent of the region’s population is urban—including half of the region’s poor—suggesting that (i) food trade is essential; and (ii) subsistence farming, even in times of crisis, is not an alternative survival strategy for the vast majority of Latin Americans.

In 2006, more than 71 million tons of food products with a value of over \$US21 billion were imported into the countries of South America and Mexico. Of this sum, a little over a third was comprised of intra-regional trade.<sup>5</sup> The remainder, well over 50 million tons of food products, is imported per year into LAC from outside of the region. The majority of those food products arrives by ocean shipping and is thus subjected to every step of a logistics chain, including maritime transport, port transfers, customs clearance and inspection, warehousing, modal transfers, domestic rail, trucking and/or barge shipping and final distribution. These steps typically add 30 to 100 percent onto the price of delivered goods,<sup>6</sup> and in exceptional cases—such as fruit imports to the Caribbean islands—may triple the cost of a product from the time it leaves its home of origin to the time it arrives at market.

*What Food Importer and Exporters Buy from Abroad:* The blend of products imported depends upon the consuming habits of the local population and the range of locally produced staples. For the region’s net importers of food—the Caribbean islands, Mexico, Venezuela and El Salvador—meat, fish, and dairy represent the largest share of all food

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<sup>3</sup> LAC spends nearly twice as much as the U.S. on transport and logistics cost as a share the goods’ value, with Argentina representing the lowest extra costs (22 percent above the U.S.) and Paraguay the highest (3.5 times the U.S. level): IADB (2008)

<sup>4</sup> About 3 of every 10 pesos’ worth of food expenditures in Mexico are captured by Wal-Mart, and rates are similar for Ahold in Costa Rica and Carrefour in Argentina (TI, 2008).

<sup>5</sup> Figures based on BTI (2007) for Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay, and Venezuela

<sup>6</sup> See supply chain analyses presented later in this paper.

imports by value (26 percent). These perishable foods are followed by dry and liquid bulk products: cereals (22 percent) and fats and oils (14 percent). Fruits and vegetables make up 11 percent of import by value while sugar and beverages represent 4 percent. The remaining food imports (19 percent) fall into the category of “other,” which includes live animals other than fish, coffee, tea, cocoa, spices, and manufactured foods as well as feeding stuff for animals.<sup>7</sup>

The region’s net food exporters also depend on imports for an important part of their food supply although the types of food they import are, on the whole, different than those of LAC’s net importers. On a weighted-average basis, the dry bulk items—ie., “cereals” constitute by far the biggest share of net exporters’ food imports at 31 percent by value. This is followed by meat, fish, and dairy (14 percent), fats and oils (11 percent), fruits and vegetables (11 percent), beverages (5 percent), and sugar (4 percent). The primary difference between net importers and net exporters is that the net exporters are supplying themselves with a higher share of perishable goods—meat, fish and dairy—while almost all countries are dependent upon grain imports.<sup>8</sup> For instance, while meat/fish/dairy and fruits/vegetables make up over half of all imports by product value into the island countries of the Eastern Caribbean, those two categories make up only 18 percent of Peru’s imports. In contrast, dry and liquid bulk products make up over half of all of Peru’s imports by value.

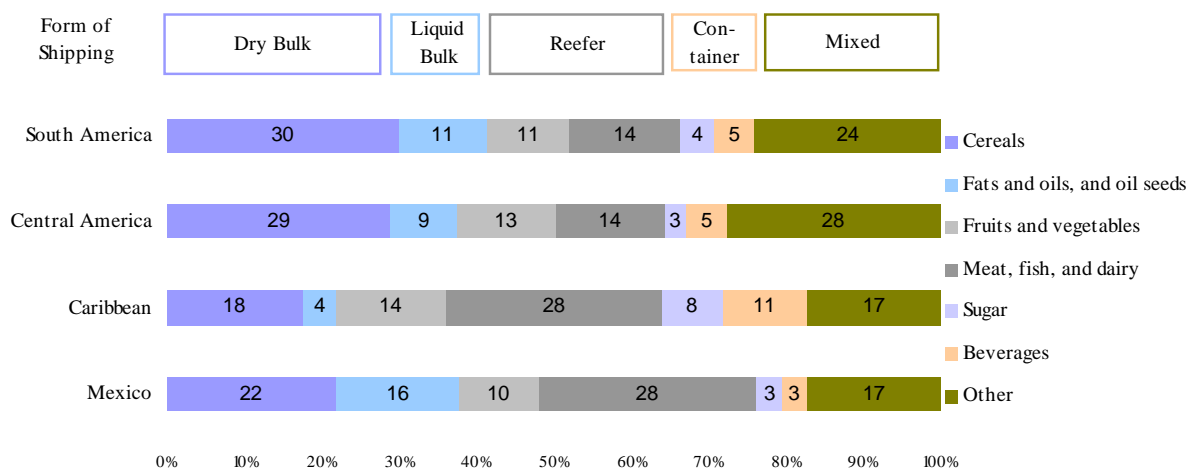
This dispersion of product types in the importing basket can provide an important indicator for policy makers as to where they should focus their attention when trying to combat the prices of food. The data above suggest that the island countries of the OECS, for example, need to work to reduce the cost of refrigerated containerized traffic (herein referred to as “reefer”). Peru, Brazil, Bolivia and Colombia, on the other hand, would do well to focus their efforts at improving the importing and distribution process for dry bulk goods such as cereals. The Diagram below illustrates the relationship at the sub-regional level between types of product and forms of shipping.

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<sup>7</sup> WDI from UN COMTRADE (2006). For a full breakdown of food imports for net food importing and exporting LAC countries, see Annex 2.

<sup>8</sup> Argentina is largely self-sufficient in grains and cereals.

**Diagram 1.1: Food Imports by Category in Latin America, in value terms in 2006**



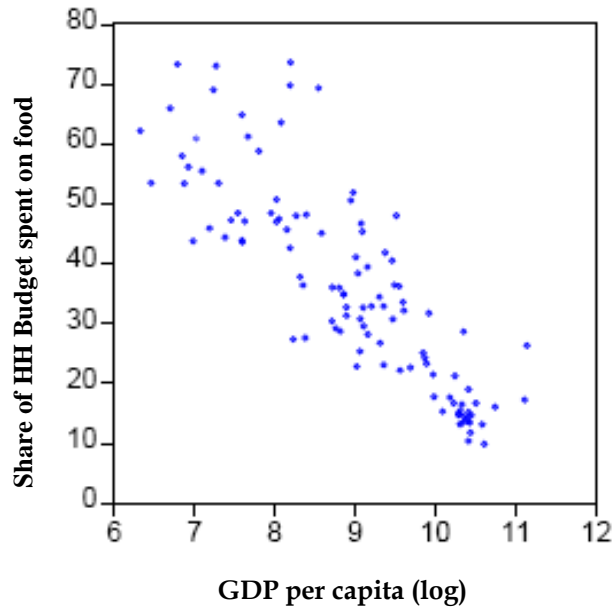
Source: WDI (2008)

### 1.3 Food Affordability and the Consumption Patterns of the Poor

Household expenditures of the poor remain disproportionately sensitive to food prices. Food has been the largest category of expenditure in the region. This was true before the recent surge of commodity prices, during the surge and since the surge. Consumer expenditure on food products ranged from between 20.2 and 29.5 percent of total consumer expenditure in Latin America.<sup>9</sup> However, according to global household surveys, in the case of the poor, up to 70 percent of household budgets are being spent on food.

<sup>9</sup> Euromonitor (2008), based on six LAC countries: Argentina, Brazil, Chile, Colombia, Mexico, Venezuela

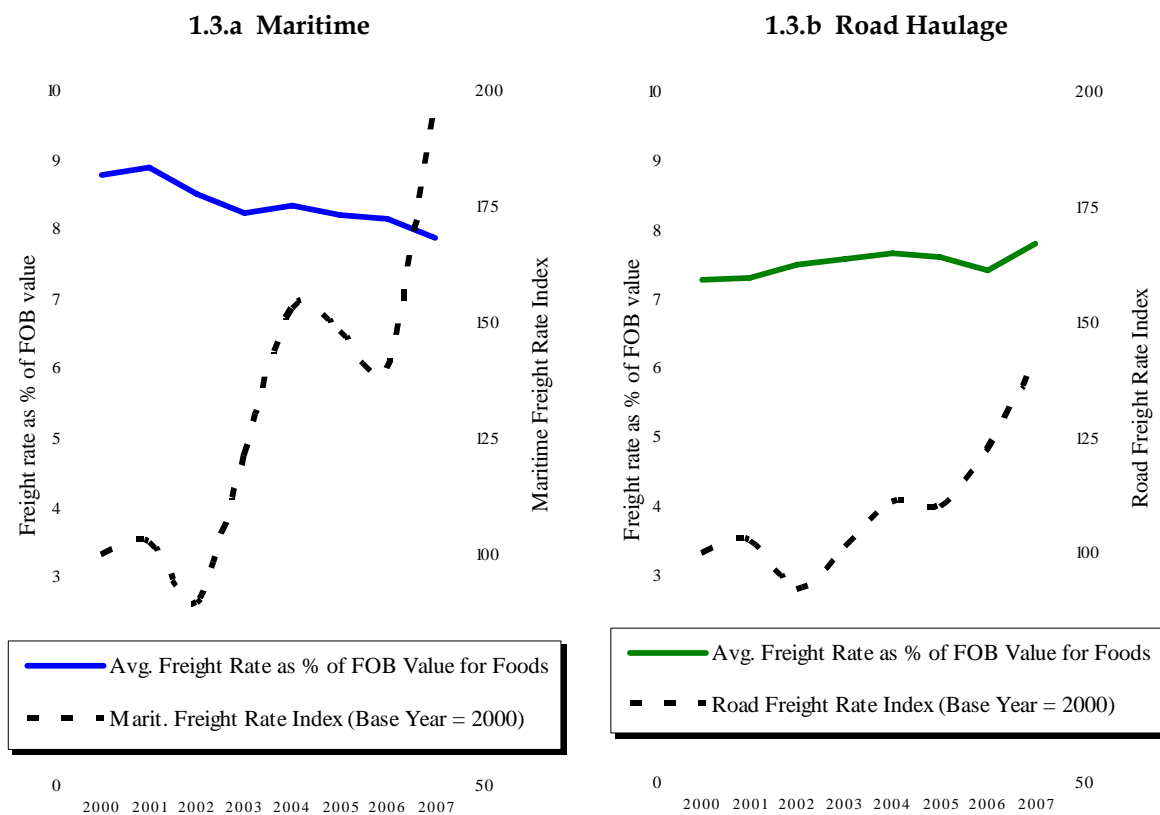
**Diagram 1.2: Expenditures on Food by Income, 2005-2008**



Source: Dessus, et al, World Bank (2008); data from household surveys.

Regardless of the shifting prices of these staple commodities in global markets, a large portion of foods are low value goods by volume and thus highly sensitive to international and domestic transport, warehousing and transfer costs. In fact, in recent years international and domestic shipping costs have risen and fallen along with commodity prices. As a result, the large impact of logistics costs on food prices has remained relatively constant throughout recent years. As the diagrams below illustrate, the rapid rise in freight prices by sea and by land paralleled the rise in commodity prices. In other words, the share of freight rates for foods remained relatively constant for both maritime and trucking elements of costs as the roller coaster of the delivered price of food rose. As ocean rates doubled from 2002 to 2007, the maritime “burden” (freight rate as share of FOB cost for food) fell slightly from 9 percent to 8 percent and as trucking rates increased by 50 percent over the same period, the land “burden” rose from about 7.5 percent to 8 percent.

**Diagrams 1.3.a & 1.3.b: Transport Costs as Share of FOB Prices of Imported Foods  
By Cargo Type, 1999 - 2007**



Source: Authors' calculations from International Transport Database (BTI) UNECLAC 2008 data

Notes: Average Freight Rates are: unweighted averages of dry and liquid bulk, general cargo, refrigerated & specialty cargoes for maritime shipment of foods; and dry bulk, general cargo and refrigerated cargo for road shipments.

### 1.4 Coming to Terms with Logistics Costs

For Latin America and the Caribbean Region (LAC) in particular, logistics and transport costs are a major barrier to trade—two to three times greater than tariffs and duties. Average import tariffs for LAC have come down since the early 1990s and remain at about 11 percent for the region—ranging from 6 to 14 percent, depending on the country. By contrast, national average logistics costs represent a share of product value of between 18 and 32 percent, compared with OECD benchmarks of around 9 percent.<sup>10</sup> On a macro-level, the World Bank has estimated LAC logistics costs as a percent of GDP as between 16 and 26 percent with the OECD benchmark again being about 9 percent.

<sup>10</sup> Guasch & Kogan (2006); Guasch (2004).

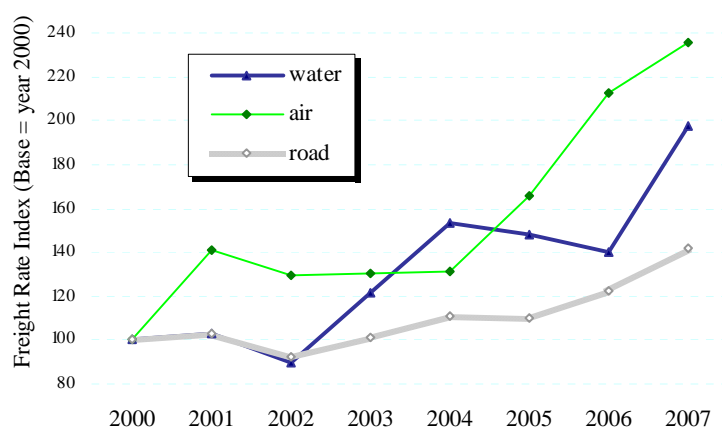
To date, concern about the region’s high logistics costs has tended to revolve around export competitiveness.<sup>11</sup> The objective of the following sections is to consider the impact of logistics on the cost of delivered goods – particularly food products – and to identify options that will help policymakers address those costs.

## 2. Logistics Costs and Food Prices

### 2.1 The Elements of Transport and Logistics Costs as they Relate to Food in LAC

Logistics and transport costs are a stubborn, underlying cost element for food in LAC. An analysis of both ocean shipping and road haulage costs as a share of imported food prices across LAC suggests that logistics and transport services remain major contributors to food prices regardless of the overall movements in commodity prices. The Chart below illustrates the rise in all forms of shipping costs as they relate specifically to food products from 2000 to 2007. Overall, trucking costs have risen 40 percent during that period while maritime costs have doubled and air shipments of high value food products rose even higher.

**Diagram 2.1: Average Freight Rates for Food Products into LAC  
By Mode of Transport, 2000 - 2007**



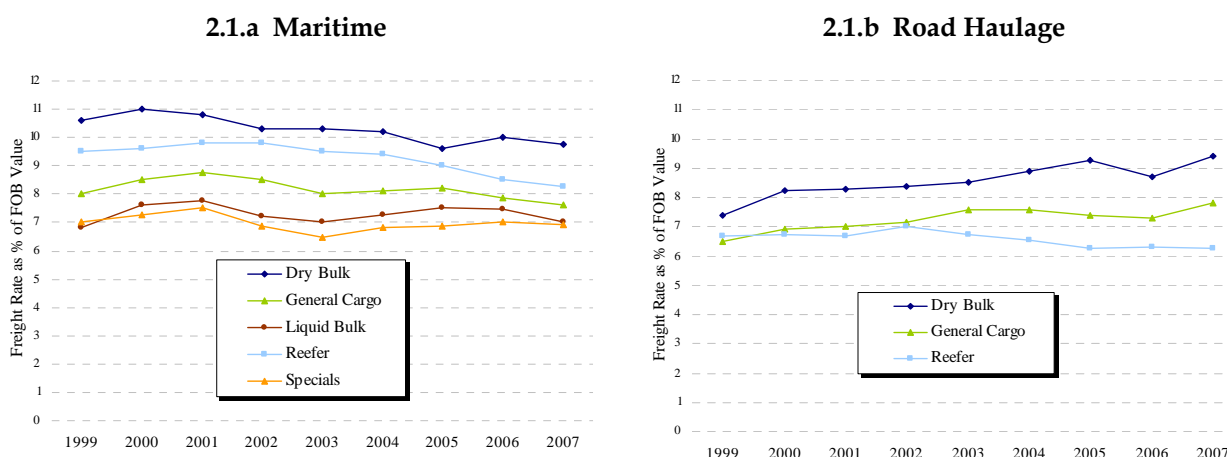
Source: Authors’ calculations from International Transport Database (BTI) UNECLAC 2008 data.

Despite these sharp changes in freight rates, transport costs as a share of imported food prices have changed very little. The Charts below consider the international legs of

<sup>11</sup> The Inter-American Development Bank, for example, recently estimated that a 10 percent regional reduction of transport costs would have nearly 20 times more impact on the region’s export levels to the U.S. than a 10 percent reduction in tariffs: “Unclogging the Arteries: A Report on the Impact of Transport Costs on LAC Trade” IADB (2008).

ocean and road shipping costs as a share of the FOB price of imported foods into LAC. Depending on the cargo type, maritime costs decreased slightly or remained relatively constant between 1999 and 2007 at 7 to 11 percent of total value. The international leg of road imports rose slightly as a share of food imports by value, from around 7 percent to 8 or 9—again depending on the cargo type. Since maritime freight rates rose slightly steeper in absolute terms than trucking rates, this means that the value of goods imported by sea rose faster than those imported by road during that period.

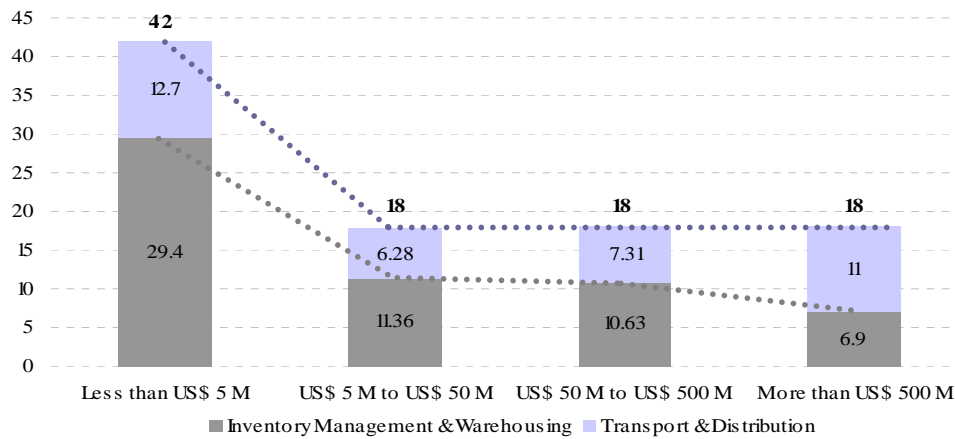
**Diagrams 2.1.a & 2.1.b: Transport Costs as Share of FOB Prices of Imported Foods  
By Cargo Type, 1999 - 2007**



Source: Authors, based on BTI, UNECLAC various years

While food products moving from producer to consumer incur a number of costs outside of the logistics chain— profits, customs duties, processing and taxes, to name a few— the transport and logistics components of the cost of delivered food products can be staggeringly high. From the perspective of a firm, domestic logistics costs in LAC may be the largest single cost element of the final price of a good. While there are important variances by sub-region and type of firm (see Annex), LAC’s logistics costs are most sensitive to the size of the firm. For small mills, markets and retailers of foods in towns and secondary cities around Latin America, the implications are clear: domestic logistics costs can total over 42 percent of the price of a firms’ sales. By comparison, larger firms spend between 15 and 18 percent of sales on logistics. This is driven by such factors as lack access to warehousing, storage and transfer facilities and the quality of the infrastructure and trucking services that link rural markets, smaller towns and secondary cities to large production and consumption centers.

**Diagram 2.2: Latin America: Average Logistics Costs by Component as % of Sales as Affected by the Total Volume of a Company's Sales**



Source: Centro Logístico de Latinoamérica, Bogotá, Colombia. Benchmarking 2007: Estado de la Logística en América Latina Anexo, María Rey Logistic Summit 2008

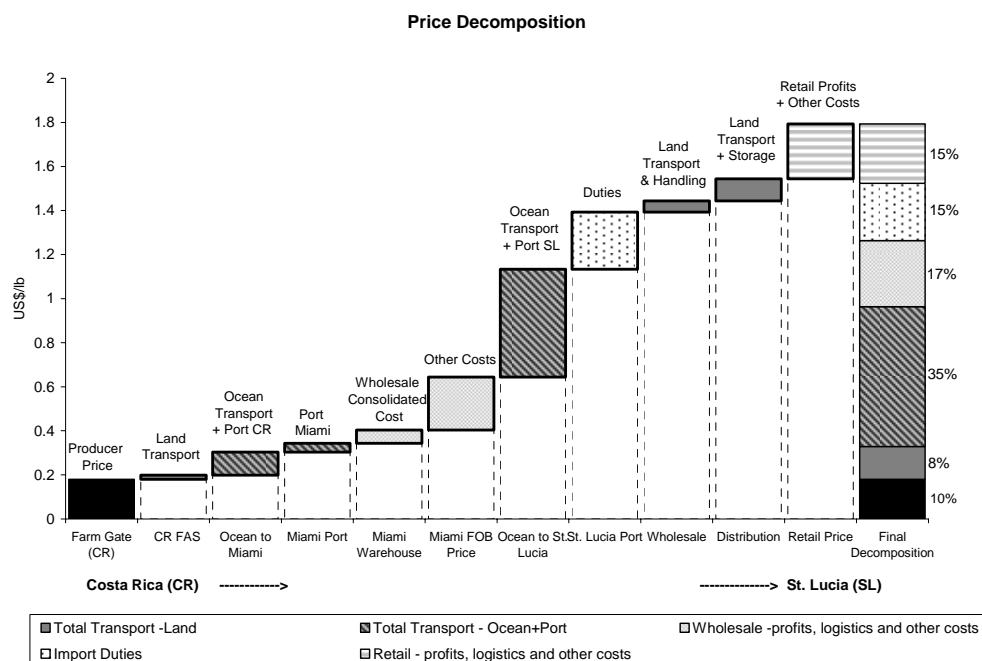
To illustrate the range of costs associated with logistics processes, below are two supply chains built around the logistics costs of food imports into LAC. This exercise describes what happens to a pineapple as it travels from the farm gate in Costa Rica to its destination in the Caribbean; and a kilogram of wheat from the time it leaves the Port of Vancouver, Canada destined for the mills of Ecuador. The two products chosen are indicative of logistics chains for foods across the diverse landscape of Latin America and the Caribbean.

The products chosen are proto-typical of food trade for their respective sub-regions—both in the costs that are borne in their shipment and in the number of modal transfers that define their logistics chains. |The island countries of the Eastern Caribbean import the majority of their perishable goods and almost all high value foods are consolidated in Miami and transshipped into the region. Likewise, grains and cereals make up the largest share of food imports to the LAC region as a whole by value—and even larger by volume as bulk goods. The US and Canada are the primary sources for those grains, particularly wheat and corn.



*Case 1: High value food imports into the Caribbean*

**Diagram 2.3: Supply Chain Analysis of Pineapples Imported into St. Lucia**



Source: Authors, freight forwarder and shipper interviews; and OECS Backward Linkages Study (2008)

As can be seen in the above summary diagram of a supply chain analysis, pineapples imported into St. Lucia are grown in Costa Rica and consolidated in Miami. Indeed, Miami serves as the consolidation center for most foods imported into the Caribbean islands. With all of that traveling and handling, the producer price of the pineapple itself represents only about 10 percent of the final delivered price. Transport costs represent the lion's share: those related to land and ocean transportation and handling account for 43 percent. In addition, storage, warehousing, consolidation and the retail and wholesale profits together represent another 33 percent—about half of which is also logistics. Because of the consolidation in Miami and the need for two ocean movements, ocean shipping represents a particularly large part of the transport costs: 3.5 times as much as the producer price for the pineapple itself. This is not a function of distance. The ocean shipping leg from Miami to St. Lucia is an order-of-magnitude more costly than the leg from Costa Rica to Miami, although the trip to St. Lucia is shorter. This will be explored further under the rubric of connectivity and economies of scale.

The transport contribution to the cost of produce in the Caribbean is not isolated to pineapples finding their way to hotels. While the share of local food supply versus imports varies by country and type of products, the Caribbean island countries rely on these imports. The OECS alone imported US\$366 million worth of food in 2007 of which only about 20 percent went to the tourism sector. Fresh products—mainly meat—account for about 60 percent of total food consumption in the region, 64 percent of which is imported. Fruit and vegetables account for 13 to 14 percent of total local food expenditure of which 30 to 40 percent is imported.<sup>12</sup>

Since the shipping structures of the islands provides for very little direct service, most food stuffs are consolidated in Miami and shipped on small carriers with relatively infrequent services that travel to multiple islands on each voyage. The results are low economies of scale in shipping, infrequent port calls, and large numbers of middlemen buying, repackaging and reselling produce. At 13 percent of FOB value, maritime transport costs to the CARICOM are significantly higher than in other regions in the world which averages 6.6 percent of FOB<sup>13</sup>.

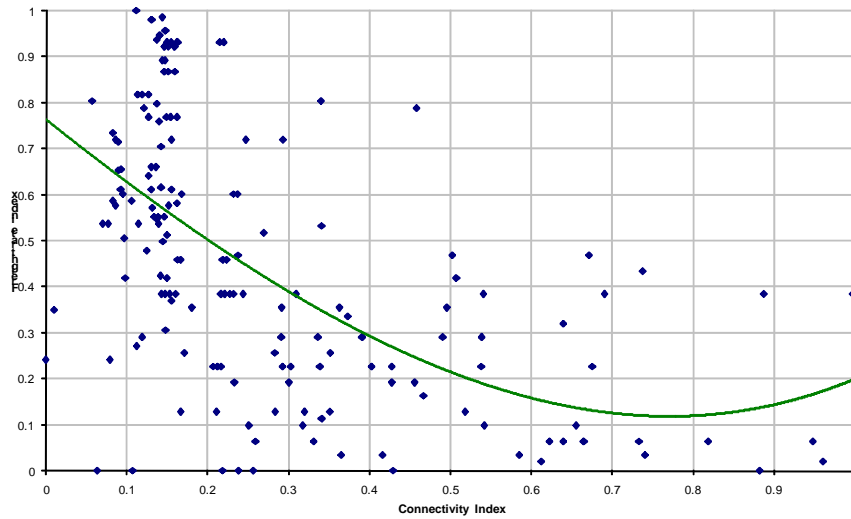
The Caribbean example illustrates the role of a country's connectivity in the cost structure of its imports, including food. The graph below, representing results of a regression analysis that is built around ocean service data for Caribbean countries, shows a statistically significant correlation between connectivity and ocean freight rates. These results confirm the importance of regular and reliable ocean services using the "transshipment connectivity index" which measures the centrality of a country within the global shipping network. In this case, if a country can "double" its centrality in the network, which would require significantly increasing its direct liner services to a wider range of countries, transport costs could decrease by over 15 percent.

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<sup>12</sup> OECS Backward Linkages (2008)

<sup>13</sup> Developed market-economy countries (5.77% of FOB)

**Diagram 2.4: Relation between Freight Rates and Connectivity, Container Shipping Caribbean Basin, 2006**



Source: Wilmsmeier (2008)

While harder to control in the short-term through direct policy interventions or investments, a country’s connectivity is an important long-term result of port reform, cargo agglomeration and the resulting attractiveness of a country as a major port of call or transshipment center.

***Case 2: Wheat into Ecuador***

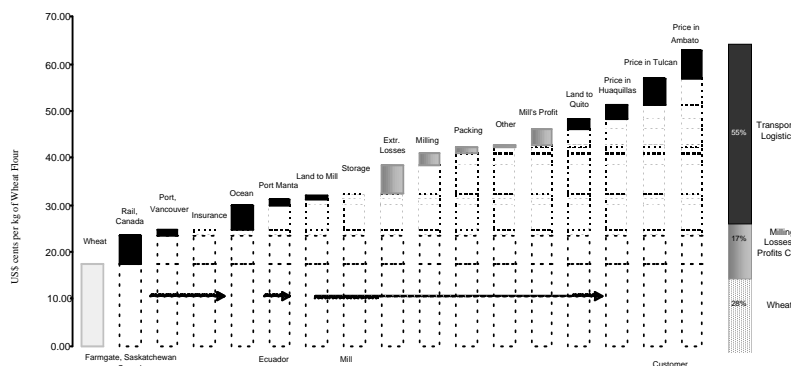
In contrast to the shipment of pineapples into St. Lucia, wheat is a basic staple for LAC consumers and is growing in importance. According to World Grain Statistics, South America imported 14 million tons of wheat in 2006/2007 and about 1.5 million tons of wheat flour over the same year. This represented a 26 percent increase over the previous year. In Ecuador, wheat is currently the fourth most important food item in terms of per capita daily calorie intake (after sugar, rice and palm oil). As a result of evolving consumption habits in which bread is eaten twice a day and pasta is emerging as a staple, the demand for wheat grew by 10 percent on average annually between 2002 and 2007.<sup>14</sup>

The figure below offers a graphic representation of the cost increases experienced in the process of transporting wheat originating in Vancouver, Canada until it is sold as wheat flour to bakeries in Quito, Ecuador. When the grain leaves the Port of Vancouver, the first

<sup>14</sup> FAO Yearbook, (2008) and FAS, USDA Grainfiles

costs incurred correspond to insurance and ocean freight charges. Once the wheat arrives at the Port of Manta, Ecuador, there are several steps that account for additional costs. Shipping companies generally deliver the wheat FAS or “alongside ship.” Therefore a cost is incurred in receiving the wheat and clearing customs. Next, the wheat is loaded on trucks and transported by road to the mill. At the mill, the grain is first stocked in silos and then milled. The efficiency of Ecuadorian mills to extract the flour ranges between 75 and 78 percent. Here it is estimated that the mill recovers approximately 37 percent of the losses by making byproducts. Once the flour is obtained, it is packed in bags of 50 Kg each. Next, administrative, marketing and financial costs need to be added. Based on interviews, these costs are estimated at 1.25 percent, although they can vary depending on the conditions of each mill. The mill’s profit is estimated at 7.2 percent which can also vary depending on supply and demand factors. Finally, the last step is transporting the wheat to the bakeries in Quito. The following table illustrates the cost components of a kilogram of wheat as it becomes wheat flour delivered to the bakeries of Ecuador’s cities.

**Diagram 2.5 Supply Chain Analysis and Cost Contributions to the Average Price of Wheat Flour Sold in Quito and other Ecuadorean Cities**



Source: Authors calculations, data from Manifiestos, Ec. millers, interviews, Winnipeg Bd. of Wheat

Note: Wheat cost includes local elevator costs. Vancouver port costs are estimates.

The Quito supply chain analysis shows that, by the time the wheat arrives at the mill, logistics costs constitute over 30 percent of the mill's purchase price. Once the cargo is unloaded in Ecuador, the cost of domestic transportation to Quito is minimal due mainly to the high degree of competition in the Quito market and the availability of good roads linking the coast and the capital city. However, when the price of wheat flour to other cities is assessed, domestic transportation costs are more significant. The delivered cost to a city such as Ambato further adds another 20 to 25 percent onto the cost of the product. The large price difference is mostly explained by the quality of the road infrastructure and the ability of trucks to make a return trip within a day when traveling to and from Quito, even though Quito is further from the port than Ambato. According to calculations for 11 cities in Ecuador, domestic transport costs per kg of flour and the price of the flour per kg are perfectly correlated, meaning that higher domestic transport costs per kg in Ambato, for example, explain the flour price difference relative to Quito.

**Table 2.1. Price of Wheat Flour in Several Ecuadorian Cities and the Contribution of Domestic Transportation to Price in 2007**

Destination	Region	Distance to Manta (Km)	Population	Number of Mills	Price/Kg Wheat Flour (US\$)	Domestic Transport Cost (US\$) /Kg Flour	Wheat as % Final Price
Ambato	Sierra	385	326,627	2	0.6300	0.1650	39.4
Quevedo	Coast	171	159,774	-	0.5880	0.1230	42.3
Tulcan	Sierra	631	83,824	1	0.5720	0.1070	43.4
Cuenca	Sierra	392	471,072	1	0.5380	0.0730	46.2
Santo Domingo	In between	211	322,080	-	0.5360	0.0710	46.4
Esmeraldas	Coast	371	179,645	-	0.5325	0.0675	46.7
Huaquillas	Coast	429	46,589	-	0.5140	0.0490	48.3
(Border with Peru)							
Manta/Portoviejo	Coast	30	476,844	1	0.4900	0.0250	50.7
Quito	Sierra	362	2,064,611	6	0.4860	0.0210	51.1
Riobamba	Sierra	408	212,420	2	0.4567	0.0105	54.4
Guayaquil	Coast	180	2,228,343	2	0.4378	0.0084	56.8

Sources: Ecuador's National Institute of Statistics and Census, interviews with Ecuadorian millers, Ecuadorian Ministry of Agriculture's Commodity Prices Statistics Unit.

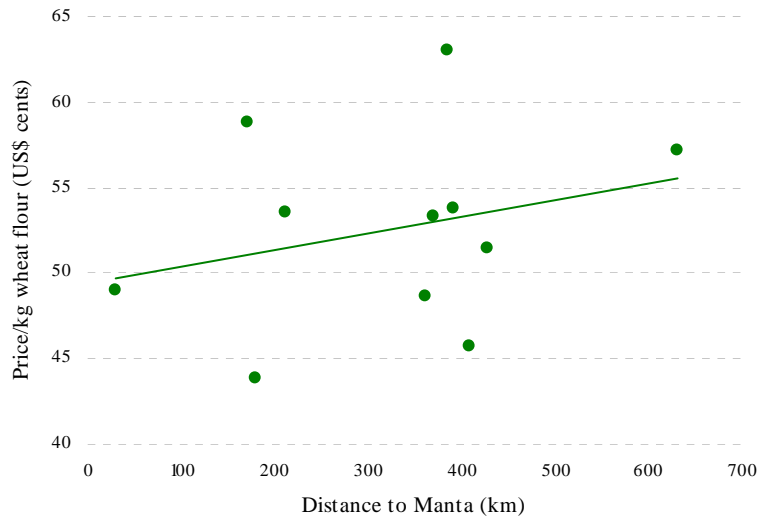
These two supply chains illustrate several points about food prices and logistics. Most fundamentally, the product that is being bought at market is only partially "food." A large piece of the product's price is derived from moving the product around, storing it, and changing hands and modes of transport. This realization applies not only to tiny Caribbean countries of 170,000 people but also to the regional giant of 170,000,000. In Brazil, imports and exports account for a large share of the country's GDP - at about 12 percent and 15 percent, respectively. In the case of Brazil's exports, transport costs represents a significant share of the

overall costs in most categories—56 percent for foodstuffs. Transport costs are also estimated to represent about 80 percent of the challenges facing the Brazilian foodstuffs sector overall.<sup>15</sup>

A second observation is that transport and logistics costs can be punishing on both high value goods—such as pineapples, and low value goods, such as wheat. That is, modern transport movements in refrigerated containers and established intermediary distribution and consolidation arrangement, such as those in Miami do not insulate a product from exposure to high freight costs.

A final important observation about logistics and food derived from these two cases relate to distance versus scale economies. On one hand, distance appears not to be a central driver of costs, either for ocean transport (note the difference in the price of shipping the pineapple from Costa Rica to Miami versus Miami to St. Lucia) or for trucks (e.g., from the Port at Manta to Quito versus from the port to other cities in Ecuador). The findings of the Ecuadorian wheat analysis, in particular, illustrate this point, as shown in the graph below. The trend line shows a slight inclination upwards in the relationship between distance and cost. Yet, even with only 11 data points, the dispersion is evident as are the exceptions to the trend.

**Diagram 2.6.. Relationship between a City’s Distance from Port Manta and the Delivered Cost of Wheat Flour**



<sup>15</sup> Brazil: How to Decrease Freight Logistics Costs in Brazil (2008) - draft

Sources: Authors' calculations, Ecuador National Institute of Statistics and Census, interviews with Ecuadorian millers, Ecuadorian Ministry of Agriculture's Commodity Prices Statistics Unit.

This observation is supported by econometric analysis correlating distance and other factors to road freight rates. Regression results confirm that the sensitivity of shipping costs to distance in road transport exists, but is modest--a doubling of distance increases transport costs by between 8.5 and 18.7 percent, depending upon the cargo type, value and specific connection points (see Table 2 in Annex 1: *Regression: Imports to South American Countries by Road Transport 2006*). This increase can be explained by operating costs, such as salaries and fuel costs, which are a function of distance. However, the relevance of distance on transport costs continues to weaken over time, in part because of the growing role of air transport. Air transport tends to be preferred to ocean transport on especially long-distance shipments. As the level of air transport costs drop relative to the level of ocean transport, long distance trade becomes relatively more attractive. Air transport is growing rapidly, a key reason being the sharp decline in the relative cost of air shipping and the rapidly falling marginal cost of air shipping cargo an additional mile.<sup>16</sup>

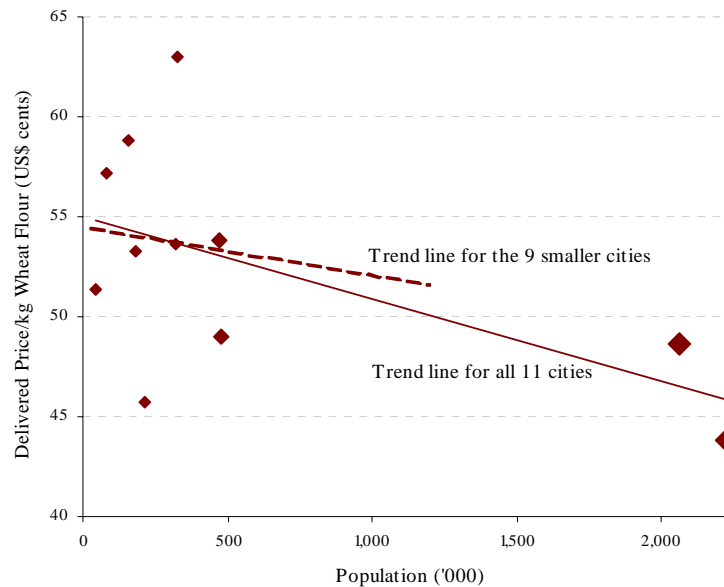
Scale economies in the form of large markets may affect transport costs, but are not a singular determinant of final food prices. While the two largest cities in the sample, Quito and Guayaquil, do command relatively low prices, the trend line is soft and the exceptions are many. In fact, when the two big cities are excluded, there is almost no correlation between size of the market and final price (or transport cost).

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<sup>16</sup> Hummels (2007)



**Diagram 2.7. Relationship between the Delivered Cost of Wheat Flour and Population for Cities in Ecuador**



Note: Larger-size markers denote larger population size of a city

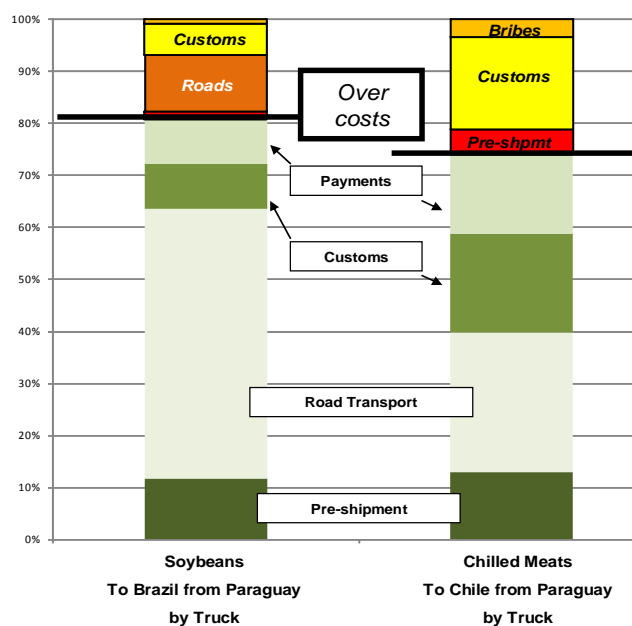
Sources: Own calculations, Ecuador’s National Institute of Statistics and Census, interviews with Ecuadorian millers, Ecuadorian Ministry of Agriculture’s Commodity Prices Statistics Unit.

On the other hand, the manner of transport does seem to matter if it can capture scale economies. The distance from Canada to Ecuador is many thousands of nautical kilometers while the distance from the port at Manta to the mill in Quevedo is only 171 kilometers. Yet, somehow, shipping a kilogram of wheat from Vancouver to Manta costs less than half of the cost of trucking that same kilo of grain from Manta to Quevedo. Roughly put, a bulk ship may hold 20,000 to 60,000 tons of grain, a single barge about 1,500 tons, one train car about 100 tons and a truck about 20 tons. If competing modes of transportation are available, agglomeration of cargo may mean economies of scale. This fact becomes important in discussing competition in domestic shipping.

The conclusions of this analysis suggest again that distance and market size are less likely to drive transport costs than infrastructure quality and competition among transport providers. Interviews with local mills suggest that the difference in costs is derived mainly from the turnaround times of the trucks which are determined, in turn, by the quality of the road. In addition, some routes are considered unsafe and thus competition among truck drivers is considerably less.

A 2006 study of intra-regional food trade identified the logistics costs for meat being imported into Chile as well as soy beans into Brazil from Paraguay. Along with the “expected” logistics costs, the authors calculated inefficiencies and other unnecessary costs burdens from losses, time delays and bribery requirements. Those costs ranged from 20 to 25 percent of the total domestic shipping, inventory and clearance costs—or a 25 to 35 percent cost over the “legitimate” logistics costs. The figure below illustrates the breakdown of those costs.

**Diagram 2.8: Logistics Costs of Intra-Regional Food Imports and Additional or “Over Costs” due to Inefficiencies, Losses, Time Delays and Bribery**



Source: CARANA 2006, Authors’ calculations

The causes of these over costs differ in the two examples.

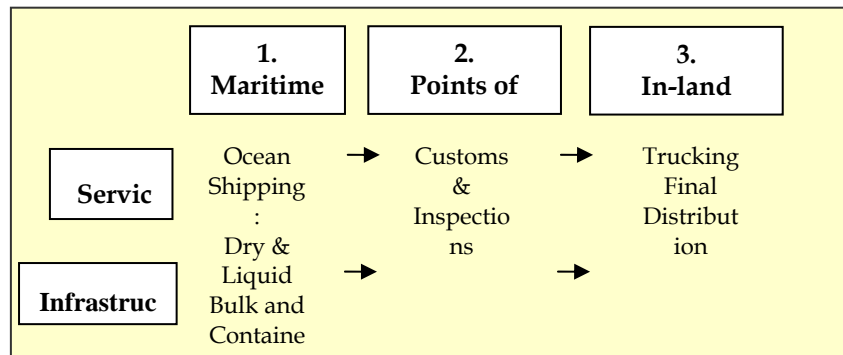
The identified logistics over costs related to this transport chain from the producer to the final destination are equivalent to US\$14.01/ton, of which 7 percent (US\$095) are related to the private sector and 93 percent (US\$13.06/ton) to the public sector. More than half of the over costs (US\$7.93/ton) are related to informal payments, inventory costs and losses of profit from incurred delays of 24 hours at the border crossing. Inefficiencies at customs clearance and related activities contribute 32 percent (4.41 USD/ton) in over costs. Finally 4 percent

(0.57 USD/ton) in over costs are related to delays in collection of payments and delays incurred from banks.

The identified logistics over costs related to this logistics chain from the producer to the final destination are equivalent to US\$3509 per truck--54 percent higher than the cost of the same shipment without over costs. Of these over costs 28 percent (US\$993) are related to the private sector and 72 percent (US\$2516) to the public sector. Over two-thirds of the over costs (US\$2391) are related to customs; 19 percent (US\$650 USD) in over costs are related to pre-shipment inspections; 13 percent (US\$468) are related to delays in collection of payments and delays incurred from banks.

Underlying factors of logistics service, scale economies and infrastructure quality seem to drive costs more than the obvious functions of distance or product value. The following sub-sections will further tease out the policy implications of these observations for each component of the supply chain as they relate to food shipments. The service and infrastructure elements of logistics are laid out in chronological order in those sub-sections as follows:

**Diagram 2.9. Logistics Chain for Food Shipments**



## 2.2 Maritime Transport

According to econometric modelling carried out for this paper, food prices are sensitive to maritime transport costs. The analysis suggests that ocean shipping rates do seem to affect the price of commodities; specifically corn, soybean and wheat are shown to be affected by maritime shipping costs within a time horizon of 24, 15 and 17 weeks. For each

increase of 10 percent of the bulk shipping index, the estimated impact on commodity prices is in the order of 1.5 percent.<sup>17</sup>

Given the effect that ocean shipping rates can assert on the price of particular delivered goods, it is necessary to explore the determinants of these rates. Since LAC countries eliminated cargo reserves for their state-owned shipping companies in the 1980s and 1990s and oversaw the subsequent privatizations and liquidations of the region's national flag carriers, it has generally been assumed that ocean shipping costs are beyond the control of government intervention. In a short-term sense, this is true. That is, governments no longer have the ability to determine freight rates by executive fiat or to influence tariffs by increasing or decreasing capacity in routes that are now controlled by the private sector. In the medium to long-term, however, a series of government actions around the region related to transport network design and port performance has had an indirect but important impact on ocean shipping rates.

Port reform, investment and efficiency gains have turned out to be a significant driver of ocean shipping costs. This, in turn, affects the costs of delivered goods, particularly food products. Since Mexico first reformed the Port of Veracruz and Colombia concessioned its four main general cargo ports in the early 1990s, most—although not all—LAC ports have undergone a tremendous growth in productivity. This has been achieved through decentralization and concessioning programs that incentivized major private sector investments and increased interport and interterminal competition. Governments have also undertaken more modest improvements to port-inland connections and harbor deepening projects.

For those ports which have been successfully reformed, a positive cycle of effects help to drive down ocean freight rates. These effects include increases in connectivity and agglomeration of cargo, resulting in the achievement of scale economies in shipping as cargo seeks the more efficient terminals. However, increases in port infrastructure endowment and efficiency, too, are important for achieving reductions in ocean freight rates, since they result in faster turnaround times for vessels, faster cargo throughput and quicker amortization of investment costs for port investors.

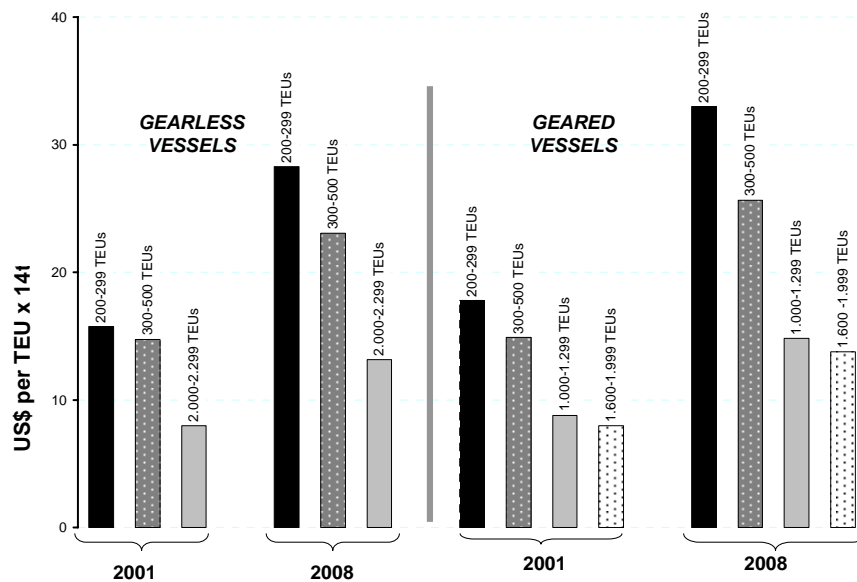
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<sup>17</sup> Authors' calculations based on autoregressive distributive lags of maritime freight rates (captured by the Baltic Dry Index or BDI) for 26 major shipping routes and the value of the commodities carried by the types of vessels in the index.

The Diagram below illustrates the significant difference between vessels that are equipped to call larger and modern ports and those that are forced to call smaller ports that cannot provide their own equipment. “Gearless Vessels” is the term for ships that do not need to have their own cranes because the ports they call have sufficient equipment to load and unload the vessel efficiently. “Geared Vessels” are those ships which have cranes on board. Not only is there a depreciation of equipment associated with those ships, but they taken up valuable space and use fuel and other costs (such as maintenance and operations) to be transported around the seas. In 2008, the charge per ton of containerized good was about 15 percent higher for the geared vessels, assuming the same sizes.

The size of the vessels calling each port—even within the categories of geared or gearless—have an even greater impact on the cost per containerized ton of cargo being shipped. In 2008, containerized cargo traveling on a 200-299 TEU capacity geared vessel will pay more than twice as much on average as cargo traveling on a geared vessel of 1000 to 1299 TEUs. The difference has grown since 2001 as larger and more efficient vessels have entered the market.

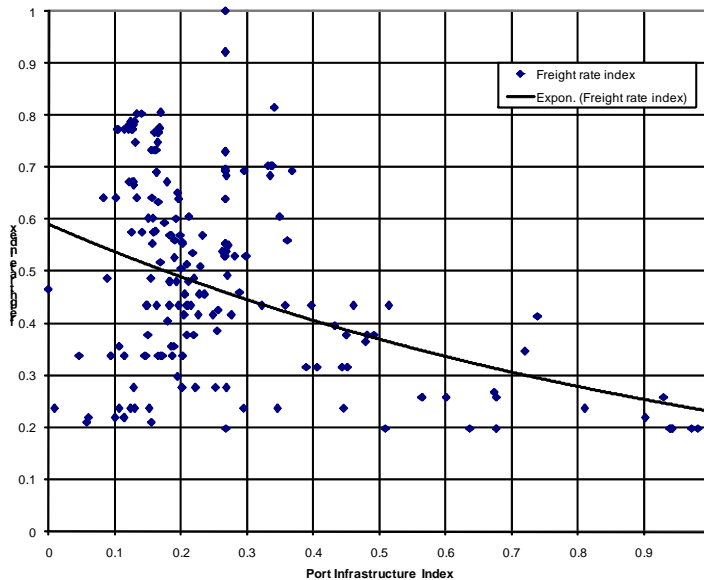
**Diagram 2.10: Hamburg Index Freight Rates for Containerized Cargo  
Gearless and Geared Ships, 2001 and 2008**



Source: Hamburg Index, Authors’ Calculations

According to the results of a regression analysis of maritime costs for food imports to South America (summarized in Annex 1), port influences ocean shipping freight rates and, in turn, the delivered price of commodities.<sup>18</sup> The figure below visually illustrates this causal relationship for the Caribbean region, specifically. The ranking of port infrastructure values such variables such as draught, length of berth, storage areas and lack of bottlenecks to cargo throughput. Actual ocean freight rates were uncovered and applied to ports according to the physical endowment of each facility which is ranked on an index of 0 to 1.

**Diagram 2.11: Relationship between Port Infrastructure Endowment and Freight Rates in the Caribbean**



Source: Wilmsmeier (2008)

<sup>18</sup> Port infrastructure endowment is described by variables such as: number of cranes, maximum draught and storage area at ports. The interaction of these variables is decisive. Installing ship-to-shore gantries, for example, may well lead to higher port charges to the shipping line. The line may still achieve an overall saving, because its ships spend less time in the port, or because it can change from geared to gearless vessels. This, in turn, will also lead to lower freight rates. However, a post Panamax gantry crane will not contribute fully to efficiency if the port access channel is too shallow for post Panamax ships. Better port infrastructure may improve efficiency, but this may be at a cost, i.e. it might actually increase port charges and consequently also the overall transport costs. The authors develop a port infrastructure endowment index based on the following set of variables, using principal components analysis: Number of Terminals, Opening hours office 24/7, Quay operation 24/7, Reception and delivery 24/7, Total port area, Storage capacity, Reefer points, Number of berths, Average berth length, Maximum draught, Maximum berth length. For descriptive statistics see Annex 2

Port efficiency not only affects the cost of ocean shipping, but also the costs incurred by cargo-owners and consignees. A poorly run or otherwise inefficient port will serve as a tax on cargo because storage, warehousing, inventory and demurrage charges are accrued when ports hold up cargo and delay delivery. A comparison of total ship costs for a port stay of a similar ship between Limon-Moín, Costa Rica, and Cartagena, Colombia, reveals the relevance of the value of time. The Port of Limon-Moín posts a US\$28/TEU cost advantage of Cartagena based solely on port charges to cargo and vessel. However, this advantage disappears when the value of time is included in the cost equation, leaving Limon-Moín with a cost per TEU that is US\$111 higher than that for Cartagena.<sup>19</sup> Since so many food products are perishable, the value of time is even more important for food than for dry containers carrying other types of consumer goods.

Based on an analysis of maritime trade transactions (75,928 observations) in containerized goods on most intra-Latin American trade routes, it was found that indicators for port efficiency have the greatest influence over international maritime transport costs, although, port infrastructure, degree of private sector participation, and inter-port connectivity also have a significant influence on costs. The regression analysis found that increasing the indicator for port efficiency by 1 percent reduces freight rates by 0.38 percent. Moreover, if an importing country with the lowest index of the sample were to improve its port infrastructure to the level of the best index of the sample, maritime transport costs for imports would decline by 7.4 percent.<sup>20</sup>

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<sup>19</sup> Kent, et al (2005).

<sup>20</sup> *The Impact of Port Characteristics on International Maritime Transport Costs* (Wilmsmeier, Hoffman, and Sanchez, 2006)

As relative efficiency declines at a port, cargo is chased away to other ports, sending a port into a negative spiral, affecting agglomeration of cargo, and, in turn, connectivity or regularity of ocean service. In 2005, about 60,000 containers that were origin or destination Costa Rica—equaling 100,000 TEUs or 15 percent of the country’s container cargo—traveled an extra 200 kilometers over poor conditioned roads to avoid the congestion and inefficiency of the Port of Limon and to seek better services through Panama’s ports. This represented

**Port Reforms in LAC:** LAC Governments have undertaken port efficiency gains through institutional reform in most countries over the last 18 years. These reforms have ranged from the implementation of Electronic Data Interchange systems all the way to the full concessioning of port authorities.

- Following the implementation of electronic processing of information at the Port of Callao in Peru in May 2008, cargo clearance time was reduced by about 70 percent. While previously it was necessary to allow about 52 minutes to process paperwork before and after importing, current times are between 15 and 16 minutes.<sup>1</sup>
- Concessions: In the case of Cartagena, Colombia average ship waiting times dropped from 10 days to no days, and ship turnaround time fell from 72 to 24 hours after the “contraprestaciones” for the general cargo ports were signed with private management and investors in 1993 and 1994. The latter improvement is a result of increased berth productivity reached by an increase of container movements per ship hour from 7 to 52. The average time for cargo to sit at the port dropped to 2 days from 30+ days before private operations. These improvements were accompanied by a reduction of the Terminal Handling Charge (THC) from \$US984 to US\$222. Kent, et al (2004).

about \$1500 of extra road haulage fees per container for Costa Rican importers and exporters for a yearly total of US\$70 to US\$100 million in additional trucking costs. For Limon specifically, firms surveyed for a Logistics Survey carried out as part of the Country Economic Memorandum blamed deterioration of access roads and delays in the loading process caused by the availability of only one crane as serious bottlenecks. Costa Rica’s liner shipping connectivity is below what it should be for the country's income level which is both a cause and a result of the Tico cargo slipping away to Panama.<sup>21</sup>

This example illustrates the insidious ways in which port inefficiency affects cargo prices. The estimated impact of port efficiency on international maritime transport costs is significant. If the two countries in the LAC sample of ports with the lowest port efficiency rankings improved their efficiency to the level of the two countries of the sample with the highest rankings, the freight rates on the route between them would be expected to decrease by almost 26 percent.<sup>22</sup>

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<sup>21</sup> Armijos, Schwartz (2006).

<sup>22</sup> Wilmsmeier, G., J.Hoffmann, R.Sanchez, “The Impact of Port Characteristics on International Maritime Transport Costs” (2006)



A related factor driving shipping costs is the degree of competition among service providers. In a study on ocean shipping rates for a sample 189 routes within the Caribbean basin, Wilmsmeier & Hoffmann (2008) show statistical evidence, that around two fifths of the variance of the freight rate can be explained by the number of carriers operating on the given route. According to their estimates, the number of liner shipping companies providing direct services between pairs of countries appears to have a stronger impact on the freight rate than does distance. Based on *CompairData* from various years, the authors' analysis of ocean shipping service structure formally shows a significant number of shipping lines competing in the South America region. However, the number of shipping companies can only serve as a relative indicator for the level of real competition, since it does not account for any existing alliances or other agreements, such as slot charters.<sup>23</sup>

As the increases in general freight rates are initiated by private shipping lines, they are largely out of reach of public intervention. Consequently, price arrangements of the oligopolistic structure of maritime service providers lead to an overpricing of services, which increases product prices for imported goods.<sup>24</sup>

Price setting in transport and logistics markets significantly depends on the level of effective competition, and competition in the transport markets depends on the size of the market and effective market regulation. In the presence of collusive behaviour, atomization and monopolies have potential impacts on price structures. Sanchez and Wilmsmeier (2009) analyse the evolution of competition and contestability on the East Coast of South America (ECSA) and the West Coast of South America (WCSA) between 2000 and 2008. They find that market contestability is "impeded" by collusive behaviour and strong alliances among carriers, thus allowing market entrance only to strong global carriers.

The service structures that use alliances among regional carriers and global shipping lines are partly a consequence of the type of cabotage regulations prevalent in South America, especially on its east coast. The structure of capacity supply for East Coast South America to Asia and Europe trade suggests that leading global carriers are using regional shipping lines to overcome the existing cabotage restrictions. Consequently, companies like Alianca, CSAV Brazil and Maruba face the prospect of being "converted" into regional feeder operators. While capacity supply between 2000 and 2008 has expanded, effective competition has been

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<sup>23</sup> Paraphrasing Gordon's paper pp 102-103

<sup>24</sup> Gordon's January 28 version pp 72

declining, and high entrance barriers and collusive behaviour among existing players in the market prevail, as evidenced by the almost complete absence of new entries in the market.<sup>25</sup>

### 2.3 Customs Clearance and Border Crossings

As can be seen from the Ecuadorean wheat supply chain, just because a food product has arrived in port does not mean that it has yet truly arrived at its destination. In fact, the hurdles and costs may only just be beginning to accrue. Regression analysis conducted for this paper of data for customs clearance times and transport costs reveal that that delays in customs clearance in LAC increase transport costs by between 4 and 12 percent. That is, if time for customs clearance could be halved, transport costs could be reduced by that same percentage. The worse the performance of the customs gates in question, the greater the potential savings. (See Annex 1 for the regression results.)

This finding is consistent with LAC firm perception surveys from Investment Climate Surveys, Doing Business Surveys and the Logistics Performance Index (LPI). In terms of customs efficiency and organization, the LPI's first dimension, LAC as a region in the 2007 survey received a score of 2.5 (out of 5)—considerably lower than the firms of India or China ranked their own customs practices. According to firms surveyed for the Logistics Performance Index (LPI) of Brazil, deficiencies in the country's customs performance are perceived as presenting more significant challenges to business operations than those related to infrastructure or to logistics operators.

*Border Crossings versus Barriers:* The regression analysis of border crossing and customs to freight rates illustrates the importance of ease of movement across national borders. The existence of a direct land access of any type reduces transport costs by around 6 percent. Moreover, a doubling of the number of border crossings could reduce transport costs by another 6 percent. These findings underline the importance of infrastructure development along international corridors in the region and specifically the improvement of border crossings. However, the isolated development of infrastructure is not sufficient, because borders crossings also comprise customs procedures.

According to Doing Business indicators, the average cost of trading across borders the LAC region is US\$1,196 per container in the case of imports, and US\$ 1,036 per container for

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<sup>25</sup> Paraphrasing Gordon's paper pp 55

exports. The cost of imports per container, however, varies quite notably across the region's countries—from US\$ 685 in Chile to US\$ 2,411 in Mexico. The comparable figure for OECD high income countries is US\$ 986. Also the time required to import - 28 days, on average - is much higher in LAC than in the U.S. or OECD, where it takes only 5 and 10 days, respectively.<sup>26</sup>

These border crossing burdens affect food prices given the importance of intra-regional trade in primary staples such as beef and grains. Regression analyses show that “over” costs from inefficiencies in the logistics chain, particularly at border crossings, represent around 20 percent of the total costs incurred in the import of Paraguayan soy beans into Brazil and beef into Chile. The unnecessary logistics costs related to beef are equivalent to US\$14.01/ton, of which 7 percent (0.95 US\$) are related to the private sector and 93 percent (US\$13.06/ton) to the public sector. More than half of the over-costs (US\$7.93/ton) are related to informal payments, inventory costs and profit loss because of delays of 24 hours at the border crossing. Inefficiencies at customs clearance and related activities contribute another 32 percent (US\$4.41/ton).<sup>27</sup>

Nearly a quarter of Argentina’s imports (in volume terms)—as well as almost 50 percent the intra-regional trade of all South America—travels through Argentine border crossings. Paso de los Libres is the busiest border crossing in South America in general and for Argentina-Brazil and Brazil-Chile trade, cereals and edible pasta being some of the main products shipped via this node. This border crossing, however, is also the one with the greatest traffic problems. About 65 percent of trucks require 30 to 36 hours to cross the border.

## **2.4 Inland Transportation: Roads and Trucks**

Road transport is responsible for handling 38 percent of all food imports into South America in terms of value.<sup>28</sup> It is also responsible for nearly all domestic movements and for a significant share of inputs to food exports—particularly in Central America and Mexico. In the Costa Rican processed food sector, for example, 52 percent of the supplies used are imported, and 48 percent are of national origin. The United States is the most important origin of the supplies, representing 13 percent of the total, while supplies imported from Guatemala represent 7 percent. Guatemalan supplies are imported via ground transportation.

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<sup>26</sup> *Cost of Doing Business 2009*, World Bank (2008)

<sup>27</sup> Carana (2006)

<sup>28</sup> BTI (2007)

Of the supplies imported from the U.S., only 18 percent travel by maritime transportation; the rest also arrive by road via neighboring countries.<sup>29</sup>

While regression results confirm the relevance of distance in road transport, they also show that the relationship is not a singularly important driver of transport costs. According to the analysis of the relationship between distance and transport costs, a doubling (i.e., a 100 percent increase) in distance increases transport costs only between 8.5 and 18.7 percent. (See Annex 1 for the results of the regression analysis.) This modest increase can be explained by the role of operating costs (salaries, vehicle wear and tear and fuel costs) in trucking services. Those same variables, however, are impacted by other factors such as trade balance (i.e., the potential for backhauling), degrees of competition, size and efficiency of the service providers and, perhaps most importantly, infrastructure quality.

Road maintenance is emerging as the greatest threat to the affordable and reliable delivery of basic goods in LAC, even for the region's more advanced economies, such as Brazil and Costa Rica. In Brazil, only 12 percent of the total road network is paved, and, due to the decline in investment in road maintenance since the 1980s, only about 25 percent of the overall road network in 2007 was rated as in good or very good condition.<sup>30</sup> As a result, the operating costs of trucking services in Brazil have increased by 10 to 30 percent, depending on region. Currently, the estimated cost of transporting 1,000 tons by road for one kilometer is about US\$45. This burden on delivered goods is playing out in all sub-regions of LAC.

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<sup>29</sup> Costa Rica ICA (2007). Based on a survey of 343 manufacturing firms in 7 industries and 3 geographical areas.

<sup>30</sup> Brazil's National Federation of Transport (CNT) Road Survey (2007).

### **Box 1: Haiti Roads, Transport Costs and the Impact on Food Prices**

In LAC's most extreme case, the condition of Haiti's road network clearly illustrates the cost of poor transport infrastructure and services on food prices and accessibility. According to recent studies that examine the cost structure of different crop and livestock enterprises, transport costs generally represent 15 percent to 30 percent of gross revenues, and are often even higher. This is largely due to the quality of the road sector. Only about 5 percent of Haiti's road network in 2004 were of "good" quality, while another 15 percent were in an "average" state.<sup>1</sup>

The impact of transport costs on Haiti's productive sector is particularly high. A 2004 study that analyzed the cost structure for a number of agricultural products traded in local markets estimated transport costs on goods as well as costs incurred by the trader as between 20% and 80% of the net margin, making transport by far the largest expense incurred by those buying and selling food.

High post-harvest losses in Haiti can largely be attributed to the poor state of the country's roads, especially secondary and access roads. More importantly, the poor quality of the road network makes access to local markets difficult, let alone regional or national markets. In 1999, Haiti had only 720 miles of paved roads out of a total of some 3,000 miles.<sup>1</sup>

In assessing the potential of various agricultural commodity chains in Haiti, it was found that poor road and market infrastructure was the major constraint that holds back agricultural growth potential, especially in the case of agricultural commodity exports, which require high quality and timely delivery.<sup>1</sup> Haiti's poor roads have also discouraged competition in the trucking industry, which has resulted in yet higher transportation costs, since bad road conditions lead to transporters incurring additional vehicle repair costs. In addition, the poor road quality also contributes to much slower turnaround time, in turn, pushing up marketing costs.<sup>1</sup>

Recent reforms initiated by the Haitian Government with the support of the donors community have allowed some limited progress in the area of emergency road maintenance, the most notable being the creation of a road maintenance fund financed by earmarked taxes (essentially a gasoline tax).

Source: Haiti Transport and Territorial Development Project, Project Appraisal Document (2006)

According to a Logistics Survey of Costa Rica, transport and logistics costs represent 24 percent of the price of processed foods produced domestically. Among firms surveyed, road quality was identified as one of the three main impediments affecting businesses in 80 percent of responses. The poor and worsening quality of Costa Rica's road network also causes direct losses from delays in shipments and breakage of 8 to 12 percent of the sales value of exported goods. The declining road quality can be partly explained by the fact that public investment in transportation infrastructure in the country has been on a decline (decreasing from between 1.5 and 2.1 percent of GDP in the mid-1980s to less than 0.5 percent in 2003. While Costa Rica today has 30 percent more paved roads per worker than the next most densely paved country in Latin America, only 32 percent of the paved roads are of good quality, and the paved road density overall has been declining from a peak in 1998, along with investment in the sector.<sup>31</sup>

Overall, the impact of transport interruptions seems to be particularly significant for firms whose main market is within Central America: they face a loss of about 5.3 percent of their consignment value. Slightly higher than the average for the country overall are also the losses experienced by non-exporting firms, since they tend to rely on road transport relatively more.<sup>32</sup>

Where railroads are prevalent in LAC, however, shippers have been unable to utilize their full potential. The share of railroad use for domestic freight transport in Argentina is relatively low, in the range of 5 to 8 percent, depending on the method of measurement. Of all containers entering or leaving Argentina's port terminals, 95 percent do so by truck, the railroad container transportation being limited by lack of access, a shortage of container bays, and the low level of coordination with metropolitan passenger services. In the case of cereals and oilseed transport to Rosario, more specifically, the railroad's relative share fell from 20 percent in 1998 to 15 percent in 2004. It has been estimated that in the case of this particular traffic alone, rail participation could be increased from 30 percent, with a consequent saving in freight costs per ton. In particular, the railroads could increase their business in the market for dry bulk - including cereals and oilseeds.<sup>33</sup>

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<sup>31</sup> Armijos, Schwartz (2006)

<sup>32</sup> Guatemala ICA (2005)

<sup>33</sup> Serebrisky, Barbero (2007)

In spite of the improvements in the country's overall railway traffic since the start of the concessions, resulting in a doubling in the total transported volume from 1997, the railroad network still presents one of the main infrastructure related challenges in Brazil. Despite carrying 22 to 26 percent of the total freight volume and 25 percent of all cargo, it remains, however, insufficient in size, has different gauges that make connectivity difficult, offers low geographic coverage particularly from the main grain belt areas, and lacks intermodality with roads and waterways. As a result, the full potential of the railroad network is not fully utilized, despite the fact that, compared to road costs, railroad costs for carrying freight are approximately 40 percent lower.

Finally, the efficiency of a country's trucking sector plays a role in its overall import cost structure. Trucking regulation, in particular, presents a paradoxical problem for many governments: costly if they do, costly if they don't. Shippers argue that tougher rules and enforcement related to weight restrictions, overloading, truck quality and safety will immediately increase transport costs which will be passed on to consumers. While it is true that transport regulations lead to costs which can be estimated, it is also true that the lack of regulation and/or enforcement of trucking regulations creates costs. Most of these are harder to estimate but they include damaged goods and increased vehicle operating costs. The costs of an unregulated trucking industry are indirect and take time to manifest themselves, but they are significant. Typically, smaller producers and the local agriculture traders are the most heavily affected by dilapidated roads and the failures in trucking regulation while large shippers using the main highways and trade corridors between large cities and ports are less affected.

- As reported in Chile's Investment Climate Assessment (2007), transport for products shipped to international market is generally better than for products destined for the national market. For example, while about 17 percent of firms report breakages in deliveries to international destinations, 25 percent report breakages in the case of national deliveries.
- In Honduras, about 37 percent of local firms incur losses while merchandise is in transport either because of spoilage or breakage due to poor road quality, and lack of

enforcement of trucking regulations. Among the other countries in LAC, the percentage of sales lost due to transport ranges from 1.5 in Brazil to 2.2 in Nicaragua.<sup>34</sup>

- In Guatemala, as a result of the aged fleet of the local trucking industry, discrimination against foreign trucks, and a lack of adequate regulations for vehicle and driver operations, about 30 percent of firms experience transport interruptions and, as a result, incur losses of an average of 1.6 percent of sales.

## **2.5 Warehousing, Storage and Inventory Costs**

High inventory costs are an important logistics bottleneck for the region, in turn, driving up the cost of delivered products. For LAC businesses, the World Bank calculates that inventory costs equal 35 percent of GDP, compared to only 15 percent of GDP for businesses in the United States.<sup>35</sup> This can be explained by the fact that, beyond the roads themselves, the storage networks of many of the region's countries are sub-standard, warehouses lack competition and effective instruments for financing inventories, and the rates of storage space rental are higher in LAC compared to other regions.<sup>36</sup>

For agricultural interests, the lack of sufficient warehousing capacity is a common complaint and is particularly costly for small shippers. As with Colombia and Brazil, storage capacity along the value chain in Argentina is particularly inadequate in the agricultural sector, largely due to the growing harvest volume and the rising shortage of vessel holds available to logistics operators. Small holders which export predominantly food products with annual values of between US\$50,000 and US\$5.5 million do not usually have a set aside logistics area, and therefore often outsource storage functions and customs clearance, among other parts of the supply process.

The need for additional storage capacity is also a consequence of the shortage of efficient intermodal transfer terminals. According to estimates, Brazil's warehousing shortage alone is currently about 40 million tons per year. If Brazil were to double its number of intermodal transfer terminals from the current 250, the total inventory and warehousing costs could be reduced by as much as US\$1 billion per year.<sup>37</sup>

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<sup>34</sup> Honduras ICA (2004)

<sup>35</sup> Guasch and Kogan (2004).

<sup>36</sup> For example, a square meter of storage has a yearly rental cost of US\$100 in the US as opposed to over US\$350 in Colombia's Free Zone in the Pacific.

<sup>37</sup> Macroligística, Brazil (2008)



### 3: Policy Guidance

#### 3.1 Policy Guidance for Maritime Service/Port Reform:

The greater goal of port services reform in LAC should be that of providing a foundation for better connectivity in terms of ocean borne transport. Typical port charges—wharfage, dockage, warehousing, cargo handling fees and provisioning—are in fact far less significant to the price of food imports or other cargoes than the costs that ports may be unintentionally levying on consumers because of inefficient practices and insufficient infrastructure. Reforms thus need to focus on investments, operational efficiency and landside linkages that will help turnaround times for large vessels and the efficient loading and unloading of cargo.

The Governments of LAC have had considerable experience with concessioning ports operation, primarily through landlord models. In Colombia, the government concessioned the port authorities themselves, which then were allowed to bring in private stevedoring and terminal operators. Unfortunately, the countries most dependent on food imports have, for the most part, not undertaken the necessary reforms and thus benefited from the lessons learned elsewhere in the region.

- Introduce modern port operating practices. Today, the ports of the region can be found in a heterogeneous state of evolution. At the most problematic levels, many of the Central American ports remain mired in the practices of the 1980s. They are yet to introduce private terminal operators who bring with them the modern practices of electronic tracking of containers, links to global shipping networks and investments in labor-reducing and time-saving gantry cranes, transtainers and other modern cargo handling equipment. The vessels that call those ports generally carry their own “gear” or cranes, are old, small and inefficient. The cost of poor shipping services that are willing to call these inefficient port conditions is passed on to consumers and local producers.
- Anticipate growth and invest in landside and waterside capacity. In concessioning and decentralizing the ports of the region, many LAC countries washed their hands of all port-related investments. While private operators made quick gains in efficiency and turnaround with “superstructure” investments such as cranes, handling

equipment and refrigerated storage, larger investments in greater yard capacity, deeper channels, wider turning basins, on-dock railroads and better landside access for roads was beyond the capacity and contractual commitments of individual private operators. Moreover, ports with multiple private operators suffer from a Prisoner's Dilemma when individually considering their competition and the incentives for port-wide investments. Many of these investments require a public commitment and regulatory function to coordinate the shared commitment and benefits.<sup>38</sup>

- Introduce spatial planning into the notion of port location expansion: Several of the ports of Central America and the Caribbean remain unplanned, congested and stuck within cities. This is also a growing concern of ports in Argentina, Colombia and Brazil. While the colonial powers built many of the region's great trading cities around or near ports, the requirements of a modern port operation are anathema to large cities. Efficient cargo flows are hampered by congestion, foot traffic, land use constraints and bridge clearance restrictions. Port expansion and location plans benefit when divorced from labor considerations that encourage urban operations. In moving ports outside of cities and residential areas, the economic knock-on effects in terms of productivity, job creation and consumer prices are likely to outweigh the short-term dislocations of local stevedoring and warehousing jobs. (See Annex 2 for an analysis of the impacts of landside congestion in Argentina's ports.)
- Encourage consolidation or coordination of small private operators: While decentralization and competition have been helpful to many of the regions' ports, atomization is a regressive curve of problems for port operations. Several island countries in the Caribbean, as well as Guyana and Belize, have a multitude of small private terminals, often controlled by vertically integrated operators. Most of these countries do not have a unifying port authority, a national transport plan, an active port regulator or any way of monitoring the anti-competitive practices of the private operators. Given the importance of cargo agglomeration, planned development, competition in carrier services and access of third party cargo to port facilities,

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<sup>38</sup> Brazilian ports, for example, suffer from serious dredging backlogs and lack container handling capacity and post-Panamax facilities. The low container capacity presents a significant bottleneck for the sector: 4 of 5 main ports in Brazil reached their capacity in 2007. According to ship owners, Brazil's ports in 2007 lacked a total of 1.1 million square meters. In order to maintain their current operating levels, 5.4 million square meters will have to be added by 2012. See *Containerisation International*, Balau, et al., (2007)

governments may benefit from establishing or strengthening the regulatory oversight of these multiple facilities and, in some cases, encouraging their consolidation.

### 3.2 Policy Guidance for Customs and Border Reform:

**Several areas of custom and border crossing inefficiencies could be addressed that would speed up processing times and decrease transport costs. These include:**

- Elimination of fines for minor documentation errors that lead to “misdeclarations”. Customs in many Latin American countries still impose heavy fines for minor errors. In Argentina, for example, a simple documentation error results in a "misdeclaration" which incurs a fine that could be double the value of the goods.

In the Port of Santo Tomas in Guatemala, customs inspection consists of a light indicator system that randomly determines the cargo that will be inspected. The system was designed to allow for a 15 percent inspection rate, but the actual rate is 90-100 percent. As a result containers spend another 7 days beyond the 5-day free storage period, after which the shipper must incur storage charges. In addition to this, customs finds that about 50 percent of the containers have discrepancies, which translates into the shipper having to pay a bond for the amount of the discrepancy. Until the bond is paid and the administrative process to resolve the discrepancy (6 to 12 months) is finalized, the shipper has to continue paying the storage charges.

Total cost of a call to Santo Tomas is nearly 30 percent higher than a call to Cartagena. For cargo, total charges in Santo Tomas are about \$20,000 more or \$53 more per container. The main reason behind these differences is related to the storage time imposed on shippers.<sup>39</sup>

- Clearances and Inspections could be greatly improved through better cross-border collaboration and greater coordination between phytosanitary and customs services. In Central America, across Mercosur and across the US-Mexico borders, for instance, customs harmonization to facilitate the transport of goods and to reduce costs of clearance could be addressed as an issue of regional integration and trade facilitation.<sup>40</sup> For countries that are partners in trade agreements, the duplication of

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<sup>39</sup> Kent, et al (2004)

<sup>40</sup> *Local Gains from Global Opportunities: Improving Central America's Investment Climate* (2008)

phytosanitary inspections can be avoided through the initiation of a common set of testing procedures. These may be applied only once on one side of a border crossing, using officials from both countries. This could save considerable time and costs, particularly for perishable goods.

Improved customs coordination with phytosanitary services during the hours in which both agencies are operating is also a common complaint among agricultural importers in the region. Customs clerks are often not available when phytosanitary inspectors are available and vice versa, making import approvals doubly complicated and time-consuming. Addressing this frustration may require extending the operating hours of both agencies, co-locating offices or even hiring additional staff, but it is particularly important for reducing the cost of imported foods.

- Establishment of export clearance times as the standard for import clearance times. In most LAC countries, exports clear faster than imports, probably due to the effective scrutiny of export promotion agencies and pressure from large shippers. The average days to clear import customs in the region varies widely, however, ranging from 5 in Honduras to 14 in Brazil. Import customs clearance in El Salvador and Costa Rica requires an average of 6 days, which is comparable to the average for LAC as a whole. By contrast, to clear exports, less than 2 days are required in El Salvador and Honduras, 5 in Chile and 8 in Brazil. In the OECS, import clearance times are two days longer than export clearance times on average.
- Simplification of customs declarations forms, procedures and clearance. Importing goods into an OECS takes on average 19 days and requires seven documents, while exporting goods takes an average of 17 days. All OECS countries require that a bill of lading, invoice, certificate of origin, and customs declaration be completed to import goods. Colombia and the Dominican Republic recently implemented several reforms, including the creation of a single online customs declaration and a decrease in the tax burden on companies, thus facilitating export and import procedures.
- Use of risk-based selectivity process for inspections. This will help assure fair selection of inspections, minimize opportunities for corruption and should reduce the

need for high percentage inspections. Haiti managed to reduce export time by one day by introducing risk-based inspections.<sup>41</sup>

- Harmonize customs standards for sub-regions. Particular logistics-related challenges to imports can best be addressed at the regional or sub-regional level. In Central America, for instance, customs harmonization to facilitate the transport of goods and to reduce the costs of doing so are inherently regional issues.

### **3.3 Policy Guidance for In-land Transport and Distribution**

The significant cost burden on food prices described in this section related to domestic in-land shipping is due, in large part, to road conditions throughout the region; lack of competition among modes of transport; poorly regulated trucking services; and inadequate transfer and storage facilities.

- Improve road quality. Governments around LAC are well versed in the arguments for better road maintenance: lower vehicle operating costs, fewer losses, less damage and greater producer and consumer surplus. In addition, it is widely recognized that the present value of maintaining a road regularly is an order of magnitude less than rehabilitating it once every ten years. As LAC enters a period of fiscal constraint, it may be worth reiterating the importance of road quality and the effects on food prices. The road funds of Central America and Haiti, which are derived in large part from gasoline taxes, are likely to come under pressure during periods of fiscal crisis. Yet LAC's fiscal gaps of the past have been rebalanced primarily out of lowered infrastructure investments and the results have been lower growth and a contribution to greater inequality.<sup>42</sup> These lessons should demonstrate the importance of maintaining networks and connectivity between communities, markets and the goods they depend upon.
- Strengthen trucking regulations and enforcements. While new regulations and stricter enforcements always entice fears of consumer passthroughs and political backlash, the dearth of trucking standards around the region is taxing food logistics and transport movements in general dearly. Better weight controls, inspections and standards for truck safety will reduce costly losses from damage.

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<sup>41</sup> Increasing Linkages of Tourism with the Agriculture, Manufacturing and Service Sectors, OECS, The World Bank (2008)

<sup>42</sup> Calderón, Serve (2005)

- Facilitate the development of ample storage, warehousing and transfer facilities.  
Several countries across the region have instituted policies to restrict the development of storage facilities in order to protect existing service providers or allow for easier regulatory control of importing and transfer facilities. Simple reforms related to permitting and licensing can reduce the cost of the facilities and increase their availability.<sup>43</sup>
- Strengthen logistics planning based upon more sophisticated freight flow modeling.  
The value and importance of multi-modal transport and intra-modal competition may not be fully appreciated in LAC because of the infrequent use of freight flow modeling and the general lack of data to help simulate the costs and benefits of alternative investments. Many countries in LAC have the potential to make fuller use of customs, manifest and commercial shipment data and to simulate alternative regulatory and investment decisions as OECD countries do. This requires a stronger public commitment to collection and use of freight flow data. (See Annex 3 for a more detailed discussion of the topic.)

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<sup>43</sup> As a result of simplifications in municipal licensing procedures in Honduras, the time required to build a warehouse has been reduced by 32 percent.

## Annex 1: Regression Analysis for Maritime Imports

In maritime containerised trade in South America, imports exceed exports (in terms of container volumes). While trade imbalances per se cannot be altered, organisation of the transport service market can reduce empty movements by information and equipment sharing, freight pooling, transnational cooperation of transport service providers.

Certain port and institutional characteristics, including aspects such as infrastructure development, port devolution and private sector participation can be influenced by governments. A so far neglected point is the impact of effectiveness of institutions and politics in converting plans into reality and facilitating market responses to changing environments.

A country's maritime transport costs are determined by the following key factors:

- Port: infra- and superstructure, productivity, operator model, and tariffs;
- Trade flows: imbalances, volume of trade, and complementarities of trade;
- Structure of the maritime industry: competition and offer of liner services;
- Position within the global shipping network: connectivity and centrality;
- Ship operating costs: crewing, bunker, and flagging;
- Trade facilitation: bureaucracy and customs;
- Shipped product: volume of shipment and value of the product.

A reduced form model of maritime freight rates for South American imports is used for analysis. It is assumed that imported commodities are produced in the country of export and then shipped, at a cost, to the import markets where the goods are sold. As a result of the shipping margin, the price paid by consumers in the destination exceeds the price received by producers. Since the shipping margin depends on competitive conditions in the shipping industry, similar to Clark et al. (2002) the shipping firms are assumed to be profit-maximizing identical firms and behave as Cournot competitors. Within this framework a simple constant-elasticity pricing equation can be easily derived from a fully specified general-equilibrium model (Francois & Wooton, 2001). The pricing equation relates the price of shipping commodity  $k$  (disaggregated at 3-digit level of the SITC classification) in year  $y$  from port  $i$  in Latin America to destination port  $j$ ,  $TC_{ijkt}$ , to the marginal cost of this service,  $mc(i,j,k)$ , and a profit margin term,  $\psi(i,j,k)$ ,

$$TC_{ijkt} = mc(i, j, k, t) \psi(i, j, k, t)$$

(1) Marginal costs and profit margin depend on transport service conditions, infrastructural variables of origin, transit and destination countries, external factors such as the development of the charter market and oil prices, the degree of competition existing in the market and factors inherent to the characteristics of the commodity to be transported. Assuming a multiplicative functional form, the marginal cost equation is given by,

$$mc_{ijkt} = \varphi W_{ijk}^{\alpha_1} REEFER_{ijk}^{\alpha_2} D_{ij}^{\alpha_4}$$

(2) Where  $\varphi_k$  is a dummy variable referring to product k,  $W_{ijk}$  denotes the value per weight ratio (USD per ton), REEFER is a dummy variable if the product is transported in reefer container,  $D_{ij}$  denotes the maritime distance between country i and j, The profit margin equation is given by,

$$\psi_{ijkt} = \gamma_k TRANS_i^{\alpha_6} ONTIME_i^{\alpha_7} COMPLOG_i^{\alpha_8} INFOMARKET_i^{\alpha_3} PINFRA_i^{\alpha_5}$$

(3) where  $\gamma_k$  is a dummy variable referring to product k that can be a proxy of the different transport elasticities across sectors,  $TRANS_{ij}$  denotes the centrality of the importing country in the liner shipping network, use of a ship running an open registry flag,  $ONTIME_i$  denotes frequency of shipments reaching the consignee within schedule.  $COMPLOG_i$  denotes competence of the logistics industry in the importing country.  $INFOMARKET$  denotes the size of the informal market in country i.  $PINFRA$  denotes the level of infrastructure endowment in country i.

Substituting equations (2) and (3) taking natural logs and adding an error term the empirical model to be estimated is derived as:

$$\ln TC_{ijkt} = \delta_k + \alpha_1 \ln W_{ijk} + \alpha_2 REEFER_{ijk} + \alpha_3 \ln D_{ij} + \alpha_4 \ln TRANS_i + \alpha_5 \ln ONTIME_i + \alpha_6 \ln COMPLOG_i + \alpha_7 \ln INFOMARKET_i + \alpha_8 \ln PINFRA_i + \mu_{ijk}$$

(4) where  $\delta_k = \varphi_k + \gamma_k$  and  $\ln$  denotes natural logarithms.

### **Data**

After filtering out observations with incomplete or extreme data and selecting only commodity groups that are containerizable, the database includes n 30,002 observations. Each observation corresponds to a transaction k; hence there are 26,370 values for the variables  $TC_k$  and  $W_k$ . There are seven importing countries i which lead to seven different values for  $TRANS_i$ ,  $ONTIME_i$ ,  $COMPLOG_i$ ,  $INFOMARKET_i$  and  $PINFRA_i$ . There are 176 exporting countries j, which lead to 7 times 176 minus 176 pairs of countries (the 176 exporting countries



include the 7 importing countries), which lead to 1056 different values for  $D_{ij}$ .

The international maritime transport costs are those recorded by the customs authorities of seven Latin-American importing countries, as reported in the International Trade Data Base (BTI), which is maintained by the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC).

TC is the log of the maritime transport costs, without insurance costs, of one trade transaction. For this chapter, we use the data for all food products imports of containerizable cargo of Argentina, Brazil, Chile, Colombia, Ecuador, Peru, and Uruguay.

The BTI distinguishes between the country of “origin”, which is where the good is made, and the country of “departure”, which is the country from where the good is exported during this particular trade transaction. We use the country of departure, which is of relevance for transport costs. The country of “origin” would be of relevance if, for example, the level of customs duties had to be determined.

The BTI does not provide information on whether the cargo was actually containerized or not. For the purposes of this chapter, we selected a group of Standardized International Trade Classification (SITC) codes at the three-digit level that are assumed to be in principle containerizable. Above all, those commodities that are usually transported as liquid or dry bulk are thus excluded from this research.

### Descriptive Statistics

	Mean	Std. Deviation	N
TC(ln)	5.6424	1.23784	26370
W(ln)	8.6862	1.50638	26370
D(ln)	9.0197	.77747	26370
REEFER (dummy)	.2890	.45331	26370
PINFRA	.2589341	1.02985917	26370
COMPLOG(ln)	1.0395	.09600	26370
TRANS(ln)	6.2168	.02351	26370
INFOMARKET(ln)	1.1637	.26718	26370

### Port Infrastructure Endowment Principal Component Analysis

#### Descriptive Statistics

	Mean	Std. Deviation
Number of Terminals	18.8148	17.30430
Opening hours office 24/7	.7900	.90854
Quay operation 24/7	15.1170	15.46126
Reception and delivery 24/7	4.1201	4.99499
Total port area	3.7890E6	3.83059E6
Storage capacity	112355.2570	1.23784E5
Reefer points	3868.4908	4928.91282
Number of berths	39.6876	33.83023
Total berth length	7251.8248	7802.66606
Maximum draught	12.3920	1.76010
Maximum berth length	1150.1943	531.98929

Source: Authors

### Component Matrix

	Port Infrastructure endowment
Number of Terminals	.972
Opening hours office 24/7	.684
Quay operation 24/7	.971
Reception and delivery 24/7	.974
Total port area	.954
Storage capacity	.973
Reefer points	.983
Number of berths	.967
Average berth length	.971
Maximum draught	.935
Maximum berth length	.846

Source: Authors

Note: Extraction Method: Principal Component Analysis.

**Table 1: Regression Results - Imports to South American Countries by Maritime  
Transport 2006, SITC 3 Digit Level**

	A	B	C	D	E	F
Constant	-24.194	39.867	20.076	20.277	-26.041	-18.013
Product unitary value (ln)	0.764	0.77	0.758	0.76	0.768	0.77
	197.556	202.799	202.46	201.999	212.463	211.505
Reefer Dummy	-0.039	-0.037	-0.041	-0.04	-0.037	-0.037
	-10.101	-9.939	-11.09	-10.978	-10.36	-10.169
Distance (ln)	0.115	0.136	0.135	0.136	0.11	0.113
	30.494	36.396	36.6	36.833	31.189	31.658
Transshipment connectivity index (ln) <sup>44</sup>		-0.154				
		-40.853				
Frequency of shipments reaching the consignee within schedule (ln) <sup>45</sup>		-0.058				
		-14.974				
Competence of the logistics industry (ln) <sup>46</sup>			-0.098	-0.093		-0.021
			-24.779	-22.913		-5.526
Size of the Informal Market (ln) <sup>47</sup>				-0.028		
				-5.368		

<sup>44</sup> This index aims at reflecting the geographical aspects of the liner service supply and is based on the type of connections between countries ranging from a first- to a fourth-order connection. In the absence of direct liner shipping between two countries, the cargo will have to be transshipped in a port of a third or even fourth country in order to reach the destination country. A first-order connection is a connection without transshipment; a second-order connection is a connection with one transshipment, and so on. First-order connections have the most positive impact on cargo movement. Therefore, the type of connections per country has been weighted as follows: first order connections are multiplied by 1.0, second-order connections by 0.5, third-order connections by 0.33, and fourth-order connections by 0.25. The score is the sum of the four connection types. Source: UNCTAD, Transport Section, Trade Logistics Branch

<sup>45</sup> This variable assesses how often shipments reach the consignee within the scheduled delivery time. Respondents to the Logistics Perception Index survey were asked to evaluate the timeliness of shipments in reaching destination when arranging shipments to eight countries (major trading partners) with which they conduct business. Performance was evaluated using a five-point scale (1 for the lowest score, 5 for the highest), based on their experience in international logistics and in accordance with generally accepted industry standards or practices. Source: The World Bank, Logistics Perception Index 2007

<sup>46</sup> This variable evaluates the competence of the local logistics industry. Respondents to the Logistics Perception Index survey were asked to evaluate the competence of the local logistics industry in the eight countries (major trading partners) with which they conduct business. Performance was evaluated using a five-point scale (1 for the lowest score, 5 for the highest), based on their experience in international logistics and in accordance with generally accepted industry standards or practices. Source: The World Bank, Logistics Perception Index 2007

<sup>47</sup> This variable is based on the question: How much business activity in your country would you estimate to be unofficial or unregistered? (from 1="more than 50% of economic activity is unrecorded" to 7="none, all business is registered") Source: World Economic Forum, Executive Opinion Survey 2006

Port Infrastructure Endowment <sup>48</sup>					-0.051	-0.045
					-14.461	-12.396
R Square	0.626	0.649	0.659	0.659	0.629	0.629
Adjusted R Square	0.626	0.649	0.659	0.659	0.629	0.629
Std. Error of the Estimate	0.757	0.733	0.723	0.723	0.752	0.752
R Square Change	0.626	0.023	0.033	0	0.003	0
N	26366	26364	26364	26363	30003	30002

Source: Author

Notes: significant at 1 per cent, 5 per cent and 10 per cent. T-statistics are given in brackets. The dependent variable is the freight rate per ton of transporting good  $k$  from the exporting country  $i$  to the importing country  $j$  in natural logarithms. All explanatory variables, excluding dummies, are also in natural logarithms. Models A-E were estimated by OLS. The estimation uses White's heteroscedasticity-consistent standard errors. Data are for the year 2006.

The current study integrates the impact of centrality in the empirical analysis using a "transshipment connectivity index" which measures the centrality of a country within the global shipping network taking transshipment requirements into account. Regression results (Annex 1) show, if a country can "double" its centrality in the network, meaning a significant increase in direct liner services to a wider range of countries, transport costs can decrease up to 15.4 percent. This important finding needs to be seen in the context of the influencing variables of liner network connectivity such as ship size and frequency, which are determined by the overall level of trade, the geographic position and least but not last port infrastructure endowment and development options. Especially, the volume of trade is decisive, which can only be influenced indirectly by governments. Additionally the results underline the fact that the position within the network has a more significant impact than the notion of distance which only expresses the geographical distance between the trading partners, but not the quality of the level of quality to breach that distance.

The analysis also reviews the impact of the logistics sector development and the impact of informality. The results confirm that countries with higher level of logistics competence have lower transport costs of imports thus positively effecting food and all other

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<sup>48</sup> The port infrastructure endowment index is developed using principal component analysis, based on the following set of variables: draught, berth length, storage capacity.

containerized imports relieving the burden of transport costs. Interpreted more widely, logistics competence implies knowledge and good capacity building in the transport sector that consequently allows for better planning and more efficient operation of transport services. Therefore, it might be argued that better logistics system can ease the burden of transport costs as the gains from efficiency are converted into monetary savings for the importer and in continuation for the final consumer.

Next, the regression results demonstrate that the smaller the informal market, including informal payments, the more positive (reducing) is the impact on transport costs.

Finally, the regression analysis assesses the importance of port infrastructure endowment. This can be described by variables such as the number of cranes, maximum draught and storage area at origin and destination ports. The interaction of these variables is decisive. Installing ship-to-shore gantries, for example, may well lead to higher port charges to the shipping line. The line may still achieve an overall saving, because its ships spend less time in the port, or because it can change from geared to gearless vessels. This, in turn, will also lead to lower freight rates. However, a post-Panamax gantry crane will not contribute fully to efficiency if the port access channel is too shallow for post Panamax ships. Better port infrastructure may improve efficiency, but this may be at a cost, i.e. it might actually increase port charges and consequently also the overall transport costs. The results of the particular regression reveal that the more harmonious the development of port infrastructure the lower transport costs,<sup>49</sup> since the development of port infrastructure is worthwhile only if the entire transport system benefits and not if only bottlenecks are shifted to another element within the system. Productivity must be considered in a system perspective for it to be of maximum value to industry. This is important from a policy perspective, emphasizing the need for co-modality and multimodal visions in policy recommendations and guidance.

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<sup>49</sup> These findings support Wilmsmeier et al (2006) who show that: increases in port efficiency, port infrastructure, private sector participation and inter-port connectivity all help to reduce the overall international maritime transport costs.

## Annex 2: Regression Results -- Transport Costs and Road Transport Variables (Distance, Direct Access, Truck Border Crossings, Customs Clearance)

### *Modelling the determinants of international transport cost*

A similar reduced form model of international road freight costs, as described above, for intra South American imports is used for analysis. It is assumed that imported commodities are produced in the country of export and then shipped, at a cost, to the import markets where the goods are sold. As a result of the transport margin, the price paid by consumers in the destination exceeds the price received by producers. Since the transport margin depends on competitive conditions in the road transport industry, the road hauliers are assumed to be profit-maximizing identical firms and behave as Cournot competitors. Within this framework a simple constant-elasticity pricing equation can be easily derived from a fully specified general-equilibrium model (Francois & Wooton, 2001). The pricing equation relates the price of shipping commodity k (disaggregated at 5-digit level of the SITC classification) in year 2006 from country i in South America to destination country port j in South America,

Based on a multiplicative functional, taking natural logs and adding an error term the empirical model to be estimated is derived:

$$\ln TC_{ijk} = \delta_k + \alpha_1 \ln W_{ijk} + \alpha_2 \ln SCALE_{ijk} + \alpha_3 \ln NUMBORDER_{ij} + \alpha_4 \ln CUSTCLEAR_j + \alpha_5 \ln CORRUP_t + \alpha_6 \ln REEFER_i + \alpha_7 \ln BULK_i + \alpha_8 \ln DUMBRAZIL_i + \mu_{ijk}$$

Where  $\phi_k$  is a dummy variable referring to product k,  $W_{ijk}$  denotes the value per weight ratio (USD per ton),  $SCALE$  describes the total volume of shipments of product k (5 digit SITC level),  $NUMBORDER$  is the number of border crossings between countries i and j;  $CUSTCLEAR$ <sup>50</sup> is the efficiency of customs clearance in country j,  $PUBLICCORRUP$ <sup>51</sup> is the level public corruption in the importing country j,  $REEFER$  is a dummy variable that takes the value of one if a product requires refrigeration,  $BULK$  is a dummy which takes the value of

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<sup>50</sup> Effectiveness and efficiency of clearance process by customs and border control agencies | 2007 This variable assesses the effectiveness and efficiency of the clearance process by customs and other border control agencies in the eight major trading partners of each country. Respondents to the Logistics Perception Index survey were asked to evaluate the effectiveness and efficiency of clearance in the country in which they work on a 1-5 scale, based on their experience in international logistics, compared with generally accepted industry standards or practices. Source: The World Bank, Logistics Perception Index 2007

<sup>51</sup> A country or territory's degree of public corruption | 2007 The Corruption Perceptions Index score relates to perceptions of the degree of corruption as seen by business people and country analysts, and ranges between 10 (highly corrupt) and 0 (highly clean). We use the measures inverse to those published by Transparency International.

one if the transported food products are transported as bulk cargo, DUMBRAZIL is a dummy variable that takes the value of one if the importing is Brazil.

## *Empirical results*

### *Data*

After filtering out observations with incomplete or extreme data and selecting only commodity groups that are containerizable, the database includes n 6,500 observations. Each observation corresponds to a transaction  $k$ ; hence there are 6,500 values for the variables  $TC_k$ ,  $W_k$  and  $SCALE_k$ . There are seven importing countries  $j$  which lead to seven different values for  $CORRUP_j$ , and  $CUSTCLEAR_j$ . There are 7 importing and 10 exporting countries  $j$ , which lead to 7 times 10 minus 7 pairs of countries, which lead to 63 different values for  $NUMBORDER_{ij}$ .

The international road transport costs are those recorded by the customs authorities of seven Latin-American importing countries, as reported in the International Trade Data Base (BTI), which is maintained by the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC).

TC is the log of the road transport costs, without insurance costs, of one trade transaction. The BTI distinguishes between the country of "origin", which is where the good is made, and the country of "departure", which is the country from where the good is exported during this particular trade transaction. We use the country of departure, which is of relevance for transport costs. The country of "origin" would be of relevance if, for example, the level of customs duties had to be determined.

The BTI does not provide information on whether the cargo was actually containerized or not. For the purposes of this paper, we categorized groups at Standardized International Trade Classification (SITC) codes three-digit level for reefer, containerized and bulk cargo.



### Regression: Imports to South American Countries by Road Transport 2006, SITC 3

	Digital Level						
	A	B	C	D	E	F	G
(Constant)	(159.825)	(41.4648)	(-14.9825)	(-14.4957)	(1.4313)	(1.0495)	(-0.0878)
Truck border crossings	-0.1109 (-8.997)	-0.128 (-10.7309)	-0.0834 (-9.2606)	-0.0823 (-9.1777)	-0.0857 (-9.6824)	-0.0862 (-9.7457)	-0.0821 (-9.2305)
Customs clearance (ln)		0.2163 (18.1322)	0.2285 (25.4119)	0.2286 (25.5605)	0.2335 (26.4276)	0.232 (26.2663)	0.2463 (25.8836)
Public Corruption (ln)		0.1358 (11.3926)	0.1393 (15.5093)	0.1362 (15.2345)	0.1243 (14.0103)	0.1218 (13.705)	0.1435 (13.7929)
Unitary product value (ln)			0.6326 (70.3404)	0.6343 (70.887)	0.5716 (56.9974)	0.5824 (55.9541)	0.5812 (55.8842)
Dummy Reefer				-0.075 (-8.3964)	-0.0653 (-7.3886)	-0.0596 (-6.6545)	-0.0632 (-7.0254)
Volume of products shipment (SITC 5 digit)					-0.1328 (-13.196)	-0.1359 (-13.4722)	-0.1395 (-13.7866)
Dummy Bulk						0.0366 (3.8332)	0.0363 (3.8045)
Dummy Brazil							0.0448 (4.0011)
R	0.110919	0.282323	0.691111	0.695158	0.704799	0.705605	0.706479
R Square	0.012303	0.079706	0.477635	0.483245	0.496741	0.497878	0.499113
Adjusted R Square	0.012151	0.079281	0.477313	0.482847	0.496276	0.497337	0.498496
Std. Error of the Estimate	1.173449	1.132876	0.853571	0.849041	0.837944	0.837062	0.836096
R Square Change	0.012303	0.067403	0.397928	0.00561	0.013497	0.001136	0.001235
F Change	80.94058	237.8875	4947.771	70.49956	174.1355	14.69329	16.00887

Source: Authors

Notes: significant at 1%, 5% and 10%. T-statistics are given in brackets. The dependent variable is the freight rate per ton of transporting good  $k$  from the exporting country  $i$  to the importing country  $j$  in natural logarithms. All explanatory variables, excluding dummies, are also in natural logarithms. Models A-E were estimated by OLS. The estimation uses White's heteroscedasticity-consistent standard errors. Data are for the year 2006.

### Descriptive Statistics

	Mean	Std. Deviation	N
Transport Cost per ton (ln)	4.1464	1.18064	6500
Truck border crossings	3.3383	2.11040	6500
Customs clearance (ln)	.9881	.75149	6500
Public Corruption (ln)	1.1758	.22806	6500
Unitary product value (ln)	6.9679	1.18180	6500
Dummy Reefer	.1831	.38676	6500
Volume of products shipment (SITC 5 digit)	17.0504	2.80143	6500
Dummy Bulk	.1025	.30328	6500
Dummy Brazil	.2898	.45373	6500

### Correlation Matrix for Regression Variables

	Transport Cost per ton (ln)	Truck border crossings	Customs clearance (ln)	Public Corruption (ln)	Unitary product value (ln)	Dummy Reefer	Volume of products shipment (SITC 5 digit)	Dummy Bulk	Dummy Brazil
Transport Cost per ton (ln)	1	-0.11092	0.214717	0.140335	0.631978	-0.06771	-0.40668	-0.16287	-0.12086
Truck border crossings		1	0.056972	0.035035	-0.07174	0.012709	0.007935	0.037669	-0.12669
Customs clearance (ln)			1	0.041728	-0.02345	0.000206	0.042524	0.053855	-0.34038
Public Corruption (ln)				1	-0.00879	-0.04065	-0.08801	0.072191	-0.51136
Unitary product value (ln)					1	0.021778	-0.46864	-0.34128	0.006599
Dummy Reefer						1	0.065615	-0.15995	0.102663
Volume of products shipment (SITC 5 digit)							1	0.208065	0.102116
Dummy Bulk								1	-0.05372
Dummy Brazil									1

### Annex 3: Port Infrastructure Endowment Principal Component Analysis

#### Descriptive statistics

	Mean	Std. Deviation
Number of Terminals	18.8148	17.30430
Opening hours office 24/7	.7900	.90854
Quay operation 24/7	15.1170	15.46126
Reception and delivery 24/7	4.1201	4.99499
Total port area	3.7890E6	3.83059E6
Storage capacity	112355.2570	1.23784E5
Reefer points	3868.4908	4928.91282
Number of berths	39.6876	33.83023
Total berth length	7251.8248	7802.66606
Maximum draught	12.3920	1.76010
Maximum berth length	1150.1943	531.98929

Source: Authors

### Correlation Matrix

	Number of Terminals	Opening hours office 24/7	Quay operation 24/7	Reception and delivery 24/7	Total port area	Storage capacity	Reefer points	Number of berths	Total berth length	Maximum draught	Maximum berth length
Number of Terminals	1.000	.520	.993	.966	.863	.908	.968	.978	.982	.849	.878
Opening hours office 24/7		1.000	.540	.589	.833	.786	.626	.567	.520	.818	.328
Quay operation 24/7			1.000	.955	.879	.924	.956	.960	.968	.847	.878
Reception and delivery 24/7				1.000	.889	.920	.985	.986	.992	.846	.805
Total port area					1.000	.990	.914	.856	.866	.971	.744
Storage capacity						1.000	.948	.890	.904	.954	.755
Reefer points							1.000	.969	.985	.890	.787
Number of berths								1.000	.985	.840	.830
Average berth length									1.000	.838	.847
Maximum draught										1.000	.766
Maximum berth length											1.000

Source: Authors

### Component Matrix

	Port Infrastructure endowment
Number of Terminals	.972
Opening hours office 24/7	.684
Quay operation 24/7	.971
Reception and delivery 24/7	.974
Total port area	.954
Storage capacity	.973
Reefer points	.983
Number of berths	.967
Average berth length	.971
Maximum draught	.935
Maximum berth length	.846

Source: Authors

Note: Extraction Method: Principal Component Analysis.

Application of CARAS (2006)

*Example: Details Import of soy beans from Paraguay to Brazil by truck*

por camion		COSTOS OBSERVADOS POR PROCESO							SOBRECOSTOS IDENTIFICADOS			
Proceso	Costos Directos	Costos Indirectos	Tiempo Excesivo de Demoras	Costos de inventario	Costos financieros	COSTO TOTAL	COSTO TOTAL	Sobre-costos directos	Sobre-costos indirectos	SOBRECOSTO TOTAL	%	
	US\$ / camion	US\$ / camion	horas	US\$ / camion	US\$ / camion	US\$ / camion	%	US\$ / camion	US\$ / camion	US\$ / cont.		
Pre embarque	207.68	10.64	0	2.00	18.00	238.32	14.4%	0.00	30.64	30.64	8%	
Transporte terrestre	900.00	0.00	48	15.96	144.00	1060.56	64.3%	62.00	159.96	221.96	57%	
Aduana	177.80	0.00	0	0.00	0.00	177.80	10.8%	123.60	0.00	123.60	32%	
Cobranza	158.02	0.00	240	0.00	16.96	173.98	10.5%	0.00	15.96	15.96	4%	
	<b>1,444.10</b>	<b>10.64</b>	<b>294</b>	<b>17.96</b>	<b>177.96</b>	<b>1,650.65</b>	<b>100%</b>	<b>185.60</b>	<b>206.56</b>	<b>392.15</b>	<b>100%</b>	

por tonelada		COSTOS OBSERVADOS POR PROCESO							SOBRECOSTOS IDENTIFICADOS			
Proceso	Costos Directos	Costos Indirectos	Tiempo Excesivo de Demoras	Costos de inventario	Costos financieros	COSTO TOTAL	COSTO TOTAL	Sobre-costos directos	Sobre-costos indirectos	SOBRECOSTO TOTAL	%	
	US\$ / ton	US\$ / ton	horas	US\$ / ton	US\$ / ton	US\$ / ton	%	US\$ / ton	US\$ / ton	US\$ / ton		
Pre embarque	7.42	0.38	0	0.07	0.64	8.51	14.4%	0.00	1.09	1.09	8%	
Transporte terrestre	32.16	0.00	48	0.57	5.14	37.88	64.3%	2.21	5.71	7.93	57%	
Aduana	6.35	0.00	0	0.00	0.00	6.35	10.8%	4.41	0.00	4.41	32%	
Cobranza	5.64	0.00	240	0.00	0.57	6.21	10.5%	0.00	0.57	0.57	4%	
	<b>51.57</b>	<b>0.38</b>	<b>294</b>	<b>0.64</b>	<b>6.36</b>	<b>58.95</b>	<b>100%</b>	<b>6.63</b>	<b>7.38</b>	<b>14.01</b>	<b>100%</b>	

Precio FCA por camion	5,320	US\$ por camion	Precio FCA por tonelada	190.00
Precio CIP por camion	4,103	US\$ por camion	Precio CIP por tonelada	217.95

	Valor Actual	Valor sin Sobrecosto	Variacion
	%	%	%
Relacion Pre embarque / FCA	4.5%	3.9%	0.6%
Relacion Trans Terrestre / FCA	19.9%	15.8%	4.2%
Relacion Aduana / FCA	3.3%	1.0%	2.3%
Relacion Cobranza / FCA	3.3%	3.0%	0.3%
Relacion (Valor FCA - Costo Total) / FCA	69.0%	76.3%	-7.4%
Relacion Extracostos / FCA	7.4%		

Relacion Trans Terrestre / FCA	19.9%	0.0%	19.9%
Relacion Costo Directo Total / FCA	27.1%		
Relacion CGT + Costo Inv y Fin / FCA	31.0%		

*Example: Details for Import of chilled beef to Chile from Paraguay by truck*

por camión												
Proceso	COSTOS OBSERVADOS POR PROCESO							EXTRACOSTOS IDENTIFICADOS				
	Costos Directos	Costos Indirectos	Tiempo Excesivo de Demoras	Costos de inventario	Costos financieros	COSTO TOTAL	COSTO TOTAL	Extra-costos directos	Extra-costos indirectos	EXTRACOSTO TOTAL	%	
	US\$ / camión	US\$ / camión	horas	US\$ / camión	US\$ / camión	US\$ / camión	%	US\$ / camión	US\$ / camión	US\$ / camión	%	
Pre embarque	1096.13	0.00	48	660.00	0.00	1745.13	17.5%	0.00	650.00	650.00	18.5%	
Transporte terrestre	3620.00	0.00	0	0.00	0.00	3620.00	36.4%	0.00	0.00	0.00	0.0%	
Aduana	520.56	0.00	204	1482.60	576.00	2559.06	25.7%	352.47	2,038.50	2,390.97	68.1%	
Cobranza	1560.60	0.00	720	0.00	468.00	2028.50	20.4%	0.00	488.00	468.00	13.3%	
	6,796.19	0.00	972	2,112.50	1,044.00	9,952.69	100%	352.47	3,156.50	3,508.97	100%	
por tonelada												
Proceso	COSTOS OBSERVADOS POR PROCESO							EXTRACOSTOS IDENTIFICADOS				
	Costos Directos	Costos Indirectos	Tiempo Excesivo de Demoras	Costos de inventario	Costos financieros	COSTO TOTAL	COSTO TOTAL	Extra-costos directos	Extra-costos indirectos	EXTRACOSTO TOTAL	%	
	US\$ / ton	US\$ / ton	horas	US\$ / ton	US\$ / ton	US\$ / ton	%	US\$ / ton	US\$ / ton	US\$ / ton	%	
Pre embarque	46.63	0.00	48	27.08	0.00	72.71	17.5%	0.00	27.08	27.08	18.5%	
Transporte terrestre	150.83	0.00	0	0.00	0.00	150.83	36.4%	0.00	0.00	0.00	0.0%	
Aduana	21.69	0.00	204	60.94	24.00	106.63	25.7%	14.69	84.94	99.62	68.1%	
Cobranza	65.02	0.00	720	0.00	19.50	84.52	20.4%	0.00	19.50	19.50	13.3%	
	283.17	0.00	972	88.02	43.50	414.70	100%	14.69	131.52	146.21	100%	
Precio FOB por contenedor de 40 pies		65,000	US\$ por contenedor de 40 pies.									
Precio CIF por contenedor de 40 pies		68,620	US\$ por contenedor de 40 pies.									
	Valor Actual	Valor sin Sobrecosto	Variacion									
	%	%	%									
Relacion Pre embarque / FOB	2.7%	1.7%	1.0%									
Relacion Trans.Terrestre / FOB	5.6%	5.6%	0.0%									
Relacion Aduana / FOB	3.9%	0.3%	3.7%									
Relacion Cobranza / FOB	3.1%	2.4%	0.7%									
Relacion (Valor FOB - Costo Total) / FOB	84.7%	90.1%	-5.4%									
Relacion Extracostos / FOB	5.4%											
Relacion Costo DirectoTotal / FOB	10.5%											
Relacion CGT + Costo Inv y Fin / FOB	15.3%											



#### **Annex 4: Analysis of Landside Constraints and their Impact on Argentina's Port Efficiency and Transport Costs<sup>52</sup>**

Agglomerating cargo at co-located or competing port terminals is important for economies of scale in shipping, warehousing and connectivity. However, land access to ports and port capacity have to anticipate the cargo growth or else congestion will lead to higher shipping costs, loss of competitiveness of exports, transport cost burdens on imports and will stifle the sustainability of that very growth. In failing to keep up with cargo growth, several ports in Latin America have become victims of their original success in the years following the first reforms and concessions in the 1990s.

Of Argentina's total exports, 58 percent (by volume) and 31 percent (by value) move through the Greater Rosario coastal strip, one of the world's centers of vegetable oil production. The physical flow volumes have grown strongly in recent years, and port and industrial facilities have expanded; yet, no changes have been made to terminal land access infrastructure, processing plants or complementary facilities. The resulting congestion has significantly affected all logistics costs and lead to a bias in the modal allocation against railroads. Improvement to the Rosario node would have considerable synergy with the country's intention to direct a greater proportion of grain and oilseed freight onto the railroad (from the current 15 percent to 30 percent), and onto river transportation.

As a result of an increase in import flows and a growth in exports with increased added value that are shipped in containers, the terminals comprising the Buenos Aires port system (Puerto Nuevo, Dock Sud and Zárate) now account for over 90% of container movement in Argentina, reaching 1.4 million TEUs in 2005, 26% above the 1998 level. Congestion in the flow of containers at the port terminals around Buenos Aires is currently an equally critical issue as that of grain in Rosario.

The main problems characteristic to Argentina's maritime transport and ports sector in general are related to insufficient availability - lack of space and container availability and the limited vessel frequencies, - combined with a deficient infrastructure that causes port terminal congestion. Partly as a result of restrictions placed on transshipment operations at Argentine ports, a significant volume of movements takes place at ports in other countries, leading to a loss of business opportunity and increased direct and indirect costs for the

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<sup>52</sup> From: Serebrisky and Barbero, "Argentina: The Challenge of Reducing Logistics Costs (,2006)

Argentine market. Primarily for tax reasons and the requirement to clear customs within a term of 15 to 30 days, companies prefer to consolidate their inventory at other ports: approximately 100,000 containers with exports originating from Patagonian ports, for instance, are transshipped at other ports (especially Montevideo, Uruguay). Inspections levels at Argentine ports are high – at 33 percent for imports and 30 percent for exports, - while in Mexico the levels are 10 percent and 5 percent respectively. Document management at port and border crossings is still based on physical documentation, and this is a problem not exclusive to the public sector, since it also involves transactions between private firms. At ports, the document management practices significantly delay trucks within the terminal precinct, in turn, reducing available space for container storage which is currently the main capacity bottleneck.

High logistics costs may disproportionately affect smaller producers, particularly those operating in the agriculture sector. In 2005, logistics costs in Argentina for example were estimated at an average of 13 percent of the f.o.b. value of exported goods and over 14 percent for imports, with small and medium enterprises recording 45 percent higher logistics costs than larger companies.

## **Annex 5: Logistics Modeling – Using Data to Plan and Invest**

**This Annex examines the data and modeling potential of Latin America and the Caribbean Region in the context of freight flow, or logistics, planning.** Throughout the OECD, Planning Ministries and Transport Agencies rely on data from a variety of sources to simulate the decisions of shippers and travelers. They undertake these exercises to better understand the economic, financial, demographic and environmental implications of policy options related to investment in transport infrastructure and regulations that would drive logistics decisions and land use. According to the Transportation Research Board,

“For policy-decision making it is necessary to capture the increased pace of change for transportation and logistics networks, transport and logistics practices, and underlying production and consumption geography, and to produce forecasts that are sensitive to alternative policy scenarios and link them to other related models, including environment, land use, security and risk, and public finance.”  
(Transportation Research Board, 2008).

Government agencies in most OECD countries have developed data collection programs and modeling techniques that allow them to produce forecasts of freight flows which, in turn, can inform alternative policy scenarios. Often, such scenarios include the consideration of such exogenous factors as environmental and land use constraints, security and risk considerations, and public finance issues. Individual countries in Latin America, by contrast, have produced in recent years several relatively simple modeling initiatives in order to increase knowledge of infrastructure investments, trade-offs between switching modes, and transportation costs.

Data collection and modeling exercises along the lines of those employed in some OECD countries, however, are still not a common practice among either public or private institutions in the LAC region. A concerted move toward that end may help the region’s governments to invest in and influence logistics networks with greater awareness toward the benefits, costs and trade-offs associated with a given intervention.

## Respecting and Utilizing Data

### *Freight Data Collection in the OECD*

In OECD countries, national data collection programs are often created in response to legislative mandates. The intent is often to reduce the need for patchwork, overlapping or contradictory data collection by regional and local jurisdictions, and to allow national or regional planning and investment agencies to use the data. Common data collection efforts and sources include:

- Statistics on values and volumes of external trade, often disaggregated by transportation mode, along with data on the flow of commodities. Government agencies are normally responsible for collecting this information. In the U.S., for instance, the Census Bureau collects external trade data disaggregated by mode of transport, and then utilizes a Commodity Flow Survey of firms as the primary source of national data on the flow of goods by mode.
- Comprehensive sources of general macro-level logistics data collected by other OECD countries include *The Port Import Export Reporting Service (PIERS) Database*, *EuroStat*, *International Trade by Commodity Statistics (ITCS)*, *Vehicle Inventory and Use Surveys*, and *Trans-Border and Entry Freight Data*. These are derived from combinations of custom data and shipping manifests, vehicle observations and firm-level surveying.
- Countries with significant railroad traffic flows typically also record *Railroad Carload Waybills* containing information on origin and destination points, type of commodity, number of cars, tons, revenue, length of haul, participating railroads, interchange locations, and cost.
- Finally, *Waterborne Commerce Statistics* are collected to analyze and forecast foreign and domestic waterborne cargo movements at principal commercial ports and jurisdictions, including inland waterways.

### *Data in Latin America and the Caribbean*

In LAC, most countries do not have a systematic approach to collecting, organizing and analyzing existing freight transportation data, and the region in general lacks a freight

database with origin-destination matrices that could facilitate the orderly analysis of commodity flows. Government-funded freight data analyses in the region are few and far between, and have mostly been undertaken either by international agencies or academics. At the individual country level, detailed freight data collection is not universal and systematic partly because the countries' various governmental agencies involved in transportation and its data analysis are oftentimes not highly coordinated. Likewise, they often lack resources for managing and manipulating large datasets and for engaging in periodic releases of information to the public.

In contrast to the progress in processing trade data that the region's countries have made, manifest data – with the exception of data on levies, assessed for fiduciary reasons – are rarely retained. Although private firms in charge of consolidating and digitizing data often times provide this additional information in files that they deliver to the governments, it is not uncommon for this information to languish.

Comprehensive freight data is being reported mainly by a handful of regional and sub-regional organizations. For instance, the only comprehensive overview on modal split and international trade in South America in terms of volumes (tons, and value) and expenditures on trade has been published by the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC),<sup>1</sup> whose statistical information sources are derived from the International Transport Database (BTI) which contains data for the period 2000-2007, consolidated and digitized by each country's national customs service.

The Foreign Trade Data Bank for Latin America and the Caribbean (BADECEL) – also a regional organization – provides detailed trade and freight-related information. For instance, freight data, transportation costs, and trip length, among other relevant variables, for many of the region's countries are reported through the Latin American Association of Foreign Trade (ALADI). Due to limited resources, however, ALADI currently neither analyzes these data nor produces any reports. Instead, the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC) uses the ALADI data to produce a series of reports.

An attempt to develop an international trade database comparable to ALADI's was undertaken in the Caribbean based on an UNECLAC initiative. Data was collected and pooled until 2004, but then the effort was abandoned. In Central America, regional data,

specifically for maritime transport, is collected and analyzed by Comisión Centroamericana de Transporte Marítimo (COCATRAM). As in the other sub-regions of LAC, however, empirical research based on this data is limited.

Aside from the international organizations that maintain and take occasional use of the data, there are also sporadic interventions at the country level to collect trade, shipment and freight data. For example:

- Public institutions in El Salvador have started to collect and analyze customs data, recognizing that such data allow depicting and differentiating international cargo flows at border crossings, and can be used for modeling flows on international routes, thus improving the planning of installations of border crossings.
- In Argentina, simple tools like the logistics costs index published by Cámara Empresaria de Operadores Logísticos (CEDOL) have proven applicable to research relevant to the transportation industry. In addition, Argentina's Statistics Unit of the Transportation Secretariat, housed in the Ministry of Federal Planning, Public Investment and services, collects and disseminates transportation statistics for passengers and freight, which - in terms of the level of detail - is comparable to that available in OECD countries. Freight cost data, however, are missing, and the quality of the statistics could be questioned.

Likewise, while information on freight rates, transportation mode, and shipments destinations at the country level is not being processed comprehensively, countries do collect this type of data at different levels of detail, and a few publish some of the data on their national statistics institutions website. For example:

- Bolivia publishes data on modal split, transport flows through border crossings and multimodal transport chains for imports and exports.
- Brazil has begun developing programs to collect and disseminate different types of freight data. As with government agencies in other countries, Secretaria de Indústria e Comércio Exterior (SECEX), which is part of the Ministry of Indústria e Comércio Exterior, is in charge of processing trade data. In addition, the Secretaria de Transportes do Governo do Estado de São Paulo has undertaken the Origin

Destination Survey on a sporadic basis, while the Instituto Brasileiro de Geografia e Estatística is in charge of an Annual Industrial Survey.

As mandated by U.N. Agencies, countries in the region have increasingly improved their capabilities to collect and release timely import and export statistics. Central banks in the region report customs information on imports from all exporting countries at the 6-digit Harmonized System level by transport mode (ocean, air). Data include origin, destination, freight and insurance costs, volume and values (f.o.b., c.i.f.) of products and the transport mode, dutiable value, and calculated duty. They are usually available at the country level for the origin of the shipment. The collection and analysis of ship and truck manifests--another potentially very useful source of information from a freight analysis perspective--are theoretically the responsibility of a country's customs agencies. In LAC, however, they have often outsourced these services to the private sector in response to their own inability to process the vast amounts of information.

Similarly, a number of private companies in the region are involved in collecting data from bills of lading and ship manifests from international transport (e.g. Manifestos in Ecuador) and are selling the data to interested private and public parties. In some cases, governments buy this information, although interest is often mainly shown by the private sector. Specifically, shipping lines use the data for capacity planning. Yet, while private companies in the transport and logistics sector have an incentive to engage in--and push for--the collection and analysis of better and more comprehensive data, it is also common, worldwide, to keep such data secret or to limit its distribution and availability. This runs counter to the public good nature of the data and its importance for rational policy making. Therefore, there is a need for public institutions to take on the responsibility of leveraging market forces by releasing information on freight rates, volumes, values, network links, and other aspects relevant to logistics planning and by assuring that, when collection and data management are outsourced, the data can be readily purchased or obtained on request.

### ***Modeling of Freight Flows: Putting the Data to Use***

In OECD countries, a wide range of modeling techniques are effectively being used for freight and logistics planning, differing in their data requirements, level of sophistication, and specific focus.

- *Four Step Modeling*, for example, is a standard practice used by OECD countries for modeling freight flows in urban areas. Its four main steps focus on (1) trip generation, (2) trip distribution, (3) mode-split, and (4) traffic assignment. The existing national model systems for freight transport in Norway (NEMO) and Sweden (SAMGODS) employ this technique and are relatively sophisticated, judged by international standards in freight transport modeling (Burgess et al., 2002). Models of this type contain the conventional four steps (with mode choice and assignment being handled simultaneously in a multimodal assignment), as well as value-to-weight transformations and vehicle load factors. All steps are handled at the aggregate (zonal) level.

The SMILE and SMILE+ model, used in The Netherlands and the SLAM model used in several European countries, similarly, are based on aggregate (zonal) data, but, unlike other freight transport models, include the use of consolidation and/or distribution centers, so that routes between a production zone and a consumption zone can be either direct (one leg) or indirect (multi-leg), with the possibility to distinguish between different types of multi-leg transport chains (Bovenkerk, 2005; SCENES Consortium, 2000).

- *Input-output (IO) models* can be useful for general infrastructure and transport planning. Specifically, these types of models, organized by industrial sectors, are being widely applied in OECD countries for tracking the flow of revenue (or sales) between industries and households in the national or regional economy.
- *Generalized Cost Analyses* in studies of freight transport are highly applicable for estimating the costs associated with reliability, frequency of service, safety, and time of the particular transport alternative. Time, specifically, is an example of a generalized cost in freight transport.
- *Logit Models* are effectively being used for determining the amount of freight that will make a particular choice (such as mode or destination) given the “utilities” or advantages of each alternative, where utility is assumed to be a linear combination of travel time, travel costs, and measures of convenience, such as warehousing availability.
- *Origin–destination (OD) table* is a modeling technique with a capacity to distinguish between individual distribution legs, based both on trade matrices and on an empirical understanding of logistics operations. The model is an effective method for determining



the movement patterns of vehicles by primarily using observations of ground counts. The EUNET2.0 Freight and Logistics Model, for instance, was a pilot freight transport model that relied on this methodology, its main purpose being to forecast the likely characteristics of future freight and other traffic movements (WSP Policy & Research Group, 2005).

- *Spatial Interaction Models (e.g. the Gravity Model)* regard freight flows as a function of the attributes of the locations of origin, the attributes of the locations of destination, and the friction of distance between the concerned origins and the destinations. The Gravity Model, in particular, is widely applied in developed countries, for example, to estimate the economic (per GDP) impact of a country's distance from regional or global markets.
- *Commodity Chain Analyses* can be effective in identifying inefficiencies in the provision of specific transport and logistics services that are used to deliver goods to markets and, ultimately, consumers. In effect, this method of analysis implies an assessment of the costs as well as time requirements associated with particular each step in the production and distribution process - including the extraction or import of raw materials, processing and assembly of intermediate goods, and transport (often multi-modal) to consumption markets.
- *Elasticity Studies* are useful for predicting changes in flows of freight in response to changes in transportation rates and fees and changes in ports, airports, and landside infrastructure or road charges.
- *Intermodal and Transportation Inventory Cost Model (ITICM)* is a disaggregated model that can be employed to illustrate the impact of changes in policies or investments on the cost of delivered goods. More so than aggregate models, ITICM is particularly useful for modeling freight, since the different goods being shipped vary in their value, treatment requirements, logistics costs, modes, and shipment sizes.

In cases where more than a single variable characterizes a good and its movement, and where policy analyses need to consider the relationship among the various variables, disaggregated modeling is of great value. Unlike aggregate models (e.g. gravity models), models like ITICM can treat data compiled from the component elements of multiple individual shipping decisions while also capturing the impact of such individual variables

as lot size and time sensitivity of different products that are lost in aggregate models (U.S. Department of Transportation Federal Railroad Administration, 2005).

Developed in 1995 jointly by the U.S. DOT Federal Railroad Administration, the Federal Highway Administration, and the Bureau of Transportation Statistics, the model allows users to identify the particular transportation alternative that is associated with minimum total logistics costs, and to predict the degree of traffic diversion from one mode to another. For instance, a model very similar to ITICM – the Intermodal Competitive Model – was used to estimate the potential diversion from rail that would occur if vehicles of longer combinations were permitted to operate on the U.S. Interstate Highway System. Importantly, regarding such mode-to-mode traffic diversion analyses, ITICM-type models have also been helpful in developing the specific information required for policy assessment (U.S. Department of Transportation Federal Railroad Administration, 2005).

In a few instances, versions of the ITIC Model have also been employed to model the impacts of infrastructure and transport projects in Latin America. For example, in the late 1990s, an ITICM-type modeling technique was used for calculating the level of truck charges that would be required to justify the construction of a new bridge from Buenos Aires, Argentina, to Colonia, Uruguay. A second modeling exercise involved the estimation of the effects that could be expected as a result of toll changes on the Mexican Toll road program. The two analyses were carried out by the Science Applications International Corporation (SAIC), a U.S.-based consultancy.

Still, in contrast to the specificity and sophistication of the aforementioned modeling techniques used in OECD countries, in the LAC region there are relatively few examples of individual countries (their public agencies, private companies, or academic institutions) modeling freight movements to inform policy decision. Specificity and sophistication denote the expansion of the focus of conventional transportation models on network components to adequately address broader environmental and economic impacts. While some of the models described above—namely, the Generalized Cost Analyses, the Logit model, Origin-Destination Tables, Spatial Interaction Models, supply chain analyses, and elasticity studies—have indeed been used for transport and logistics modeling in the LAC region, these have predominantly been initiatives undertaken by international and regional organizations as opposed to domestic governmental or private agencies.

There are only a few examples of official research carried out by the region's countries themselves, mostly limited to data collection exercises and competitiveness-focused general infrastructure studies and data analyses of intermodal transport networks from the perspective of competitiveness, and is mostly carried out ad hoc by Competitiveness Councils, Ministries or Departments of Planning and sometimes Ministries of Economy, Finance or Commerce.

- In 2006, the Government of Chile appropriated US\$780 million to develop an infrastructure investment program (the National Plan of Infrastructure for Competitiveness) for 2007-2012, targeted to improve the competitiveness of the productive sectors nationwide. This program involves the Ministries of Public Works, Transportation and Telecommunications, and Energy and Mining, and part of it has focused on identifying the specific industries that would most benefit from investments in infrastructure. This effort is meant to be followed by attempts to prioritize these investments in three areas: (1) logistics investments in zones that are links to international markets, such as ports, airports, border crossings, and multimodal terminals; (2) investments in geographic sectors that concentrate the productive attitudes of the country, such as dynamic regions and macro-zones; and (3) logistics and infrastructure issues specific to forestry, mining, dairy and livestock, fisheries and aquaculture, fruit trees, and tourism.
- To underpin that effort, the Ministry of Planning outsourced the development of a series of in-depth supply chain analyses of key export products for competitiveness and logistics planning purposes. Data for the initiative is derived from a combination of national figures collected by line ministries on commodity flows and industry surveying.
- Colombia's National Logistics Plan - being carried out by the National Planning Department - involves the process of undertaking an assessment of the issues relevant to the country's logistics and transportation sector, including the funding needs of logistics infrastructure and the measures that would be necessary for increasing the country's competitiveness through the adoption of best practices for transport and logistics. The first step in this process was made in 2008 with the design and implementation of the 2008 National Logistics Survey,<sup>2</sup> administered by the Latin America Logistics Center - a research center specializing in logistics - and coordinated

with Colombia's Ministry of Transportation, Ministry of Commerce, Industry and Tourism, and the High Council for Competitiveness and Productivity. As input to developing the National Logistics Plan, another study in Colombia has been commissioned to identify the productive chains<sup>3</sup> that contribute significantly to the country's export performance and freight movements.

- Peru and Panama are presently undertaking their National Logistics Surveys, aimed at identifying the logistics issues in the respective countries' productive sectors, providing a baseline for the public and private sectors to make critical decisions about public policy and private practice, and recommending an action plan for the future.
- In Argentina, the initiative in creating a National Logistics Council has predominantly been taken by the Argentinean Association of Business Logistics (ARLOG) and the Business Chamber of Logistics Operators (CEDOL), organizations that aim to increase the official engagement of the private sector in logistics planning, and to recommend and assist the government in prioritizing new infrastructure works. At the level of the Government itself, however, the capacity to understand logistics issues is presently still relatively weak.

### **More Freight-Focused Planning Exercises are Carried out by Government**

#### **Institutions in Costa Rica, the Dominican Republic, and Brazil.**

- The National Transportation Plan currently developed by the Sector Planning Directorate of Costa Rica, for instance, includes a forecast of freight flows for the next 25 years and using cutting-edge simulation and forecasting models that can be easily updated using modern technologies. In the Dominican Republic, the National Council of Competitiveness is leading a series of studies aimed at identifying constraints to the movement of freight in the country' transportation system. These studies include a SWOT analysis of the port system and a characterization of the freight transportation system with a focus on trucking, as well as describe the general characteristics of the truck fleet in an effort to fill the gap in the national statistics of this type of data. It uses a survey of public and private entities to gather this information. In addition, it provides statistical information on the volume and other characteristics of imported and exported freight through the main ports, as well as information on container flows.

- In an attempt to map future commodity flows and the associated investment needs, an important planning tool - *Plano Nacional de Logística* (PNLT) - has recently been prepared in Brazil (World Bank, 2008a). Lacking a dedicated planning or implementation unit, however, the PNLT cannot be considered a complete strategy since it is not able to assess logistics-related projects in a systematic manner, as with a number of previous logistics-planning initiatives, including *Estudos dos Eixos* (Study of Axes) and *Brazil em Ação* (Brazil in Action).

### **Conclusions**

Most LAC countries still lack reliable and extensive public and private logistics data that is regularly updated, and therefore find it difficult to undertake systematic analysis not only of existing costs and bottlenecks, but also of potential efficiency gains that could be achieved through proposed large investments, such as regional logistics corridors. There is a need for data on all of the inputs that are required for the proper functioning of the logistics system, such as commodity origin and destination, costs of transport, infrastructure availability, operations indicators, and registry of users, among others.

The need for these data as well as their reliability must be validated with input from all stakeholders, including cross-support from the private sector. While international and regional organizations like UNECLAC and BADECEL, for example, do produce reports on trade and freight-related variables, the complexity of domestic and international transportation networks continues to diverge in different directions for the countries in the region, and individual countries would therefore benefit from more clearly defining their specific data needs and tools of analysis. While sophisticated modeling of that data may turn out to be prohibitively costly for some of LAC's smaller countries due to human and technical capacity constraints, the sophistication of the academic institutions, planning and economics ministries of the region suggest that a deeper and broader application of modeling for decision-making in logistics could be considered at this time.

<sup>1</sup> *International Trade and Transport Profiles* (2000); *Modal Split in Latin American International Transport* (2006)

<sup>2</sup> Detailed information about the survey is available at <http://www.encuestanacionallogistica.com>

<sup>3</sup> Productive chains subject of the study include flowers, auto parts, pharmaceuticals, meat production, soap and detergents, coffee, ceramics, home appliances and electronics, steel products, furniture, paint, paper and packaging, textiles and apparel, pesticides, cocoa and chocolate, shoes and leather goods, industrial machinery and electrical equipment, leather, plastics, and motor vehicles.

## Annex 6: Food Imports by Category for Net Food Importers and Net Food Exporters of LAC, 2006

### Breakdown of Food Imports for Net Food Importing LAC Countries (2006), by value

Net Food Importers	Food Trade Balance	Cereals	Fats and oils, and oil seeds	Fruits and vegetables	Meat, fish, and dairy	Sugar	Beverages	Other
(decreasing order of food trade balance as percent of GDP)	(percent of GDP)	(percent of food imports)						
Antigua and Barbuda*	-9.9	11%	1%	17%	33%	3%	21%	14%
St. Lucia*	-9.2	14%	2%	15%	37%	4%	15%	15%
St. Kitts and Nevis	-8.3	11%	1%	16%	35%	4%	14%	19%
Dominica	-6.3	15%	14%	8%	33%	5%	12%	14%
Barbados	-5.1	14%	6%	15%	26%	6%	17%	17%
St. Vincent and the Grenadines	-5.1	19%	2%	10%	37%	7%	12%	14%
Jamaica	-3.1 <sup>b</sup>	21%	4%	11%	29%	10%	9%	16%
Venezuela	-1.5	21%	13%	9%	17%	5%	8%	28%
Trinidad and Tobago	-1.3	17%	6%	17%	24%	8%	8%	21%
El Salvador	-0.4 <sup>b</sup>	26%	8%	16%	16%	2%	4%	28%
Mexico	-0.3	22%	16%	10%	28%	3%	3%	17%
<i>Weighted Average</i>		22%	14%	11%	26%	4%	4%	19%

Source: WDI from UN COMTRADE, latest data available, mostly 2006 also 2005 and 2004

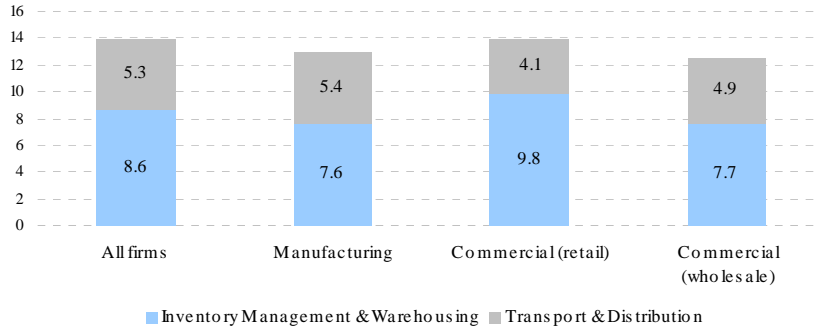
### Breakdown of Food Imports for Net Food Exporting LAC Countries (2006), by value

Net Food Exporters	Food Trade Balance	Cereals	Fats and oils, and oil seeds	Fruits and vegetables	Meat, fish, and dairy	Sugar	Beverages	Other
(decreasing order of food trade balance as percent of GDP)	(percent of GDP)	(percent of food imports)						
Guyana	28.5	23%	7%	13%	28%	3%	11%	16%
Paraguay	13.6 <sup>b</sup>	15%	7%	7%	6%	7%	24%	34%
Argentina	9.8	4%	23%	17%	17%	3%	3%	34%
Uruguay	9.4	14%	8%	11%	15%	13%	5%	35%
Nicaragua	7.9	30%	12%	9%	10%	3%	4%	33%
Costa Rica	7.3	31%	13%	16%	9%	3%	6%	22%
Ecuador	5.6	29%	10%	11%	4%	4%	7%	34%
Chile	4.9	23%	8%	7%	20%	6%	3%	34%
Bolivia	3.6	34%	19%	5%	7%	7%	4%	24%
Brazil	3.1	40%	8%	17%	17%	1%	6%	12%
Honduras	2.7	30%	5%	10%	13%	3%	8%	31%
Peru	2.5	36%	16%	5%	9%	9%	3%	23%
Panama	2.3	23%	6%	14%	15%	2%	8%	33%
Guatemala	2.1	31%	10%	11%	18%	3%	3%	24%
Colombia	1.5	41%	13%	9%	8%	4%	4%	23%
<i>Weighted Average</i>		31%	11%	11%	14%	4%	5%	24%

Source: WDI from UN COMTRADE, latest data available, mostly 2006, 2005 or 2004

**Annex 7: Domestic Logistics Costs by Sub-Region, Firm Type, Firm Size and Logistics Sub-component in LAC, 2007**

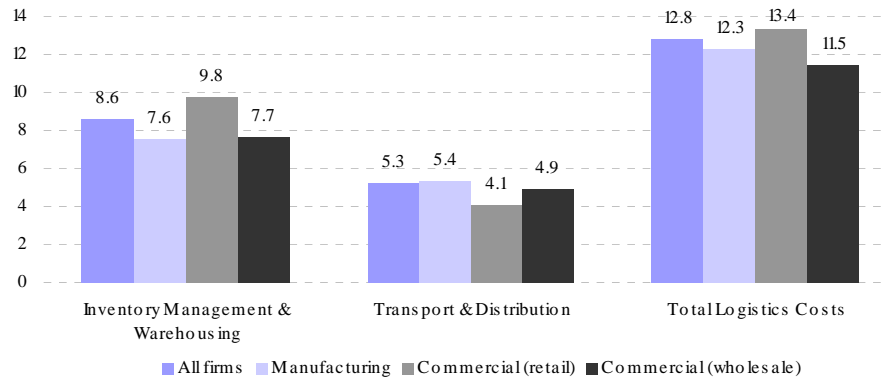
**Mexico & Central America: Average Logistics Costs by Component as % of Sales<sup>53</sup>**



Note: Data sample consists of 55 firms and does not include any firms from Panama

Source: *Encuesta Nacional Logística – Colombia 2008 Resultados del Benchmarking Logístico Empresarial*

**Mexico & Central America: Average Logistics Costs by Component as % of Sales**

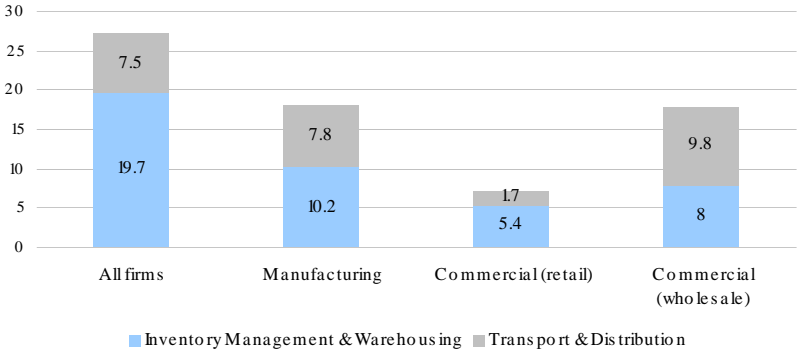


Note: Data sample consists of 55 firms and does not include any firms from Panama

Source: *Encuesta Nacional Logística – Colombia 2008 Resultados del Benchmarking Logístico Empresarial*

<sup>53</sup> Inventory Management & Warehousing includes taking of orders, inventory management, and storage. Transport & Distribution refers to the transportation and final delivery components of the logistics chain.

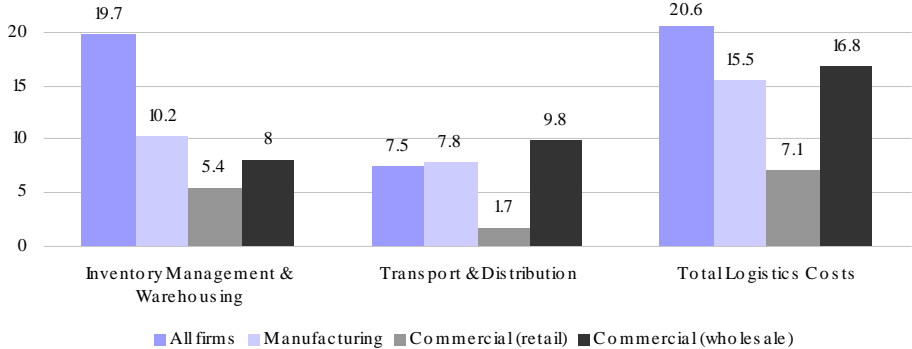
**South America: Average Logistics Costs by Component as % of Sales**



Note: Data sample consists of 85 firms in Argentina, Bolivia, Brazil, Chile, Colombia, Uruguay, and Venezuela. "All firms" also includes Logistics Services Providers, whose own logistics cost components are not shown separately.

Source: Benchmarking 2007: Estado de la Logística en America Latina Anexo a la Presentación de Maria Rey LogisticSummit 2008

**South America: Average Logistics Costs by Component as % of Sales**

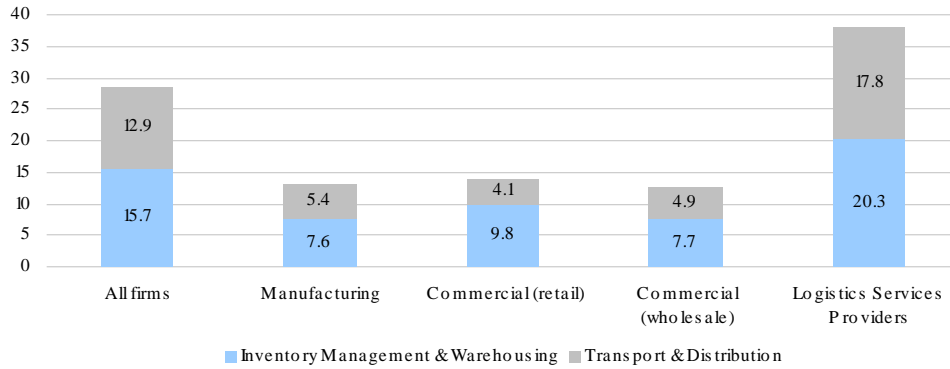


Note: Data sample consists of 85 firms in Argentina, Bolivia, Brazil, Chile, Colombia, Uruguay, and Venezuela. "All firms" also includes Logistics Services Providers, whose own logistics cost components are not shown separately.

Source: Benchmarking 2007: Estado de la Logística en America Latina Anexo a la Presentación de Maria Rey LogisticSummit 2008



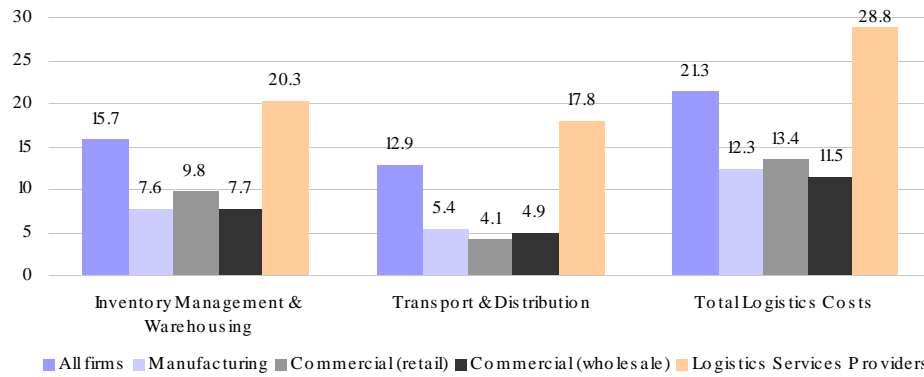
### Central America: Average Logistics Costs by Component as % of Sales



Note: Data sample consists of 51 firms and does not include any firms from Panama

Source: Benchmarking 2007: Estado de la Logística en America Latina Anexo a la Presentación de Maria Rey LogisticSummit 2008

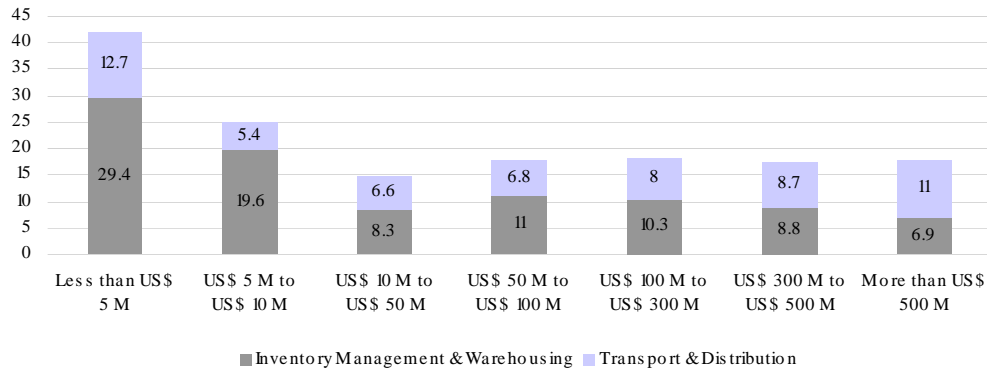
### Central America: Average Logistics Costs by Component as % of Sales



Note: Data sample consists of 51 firms and does not include any firms from Panama

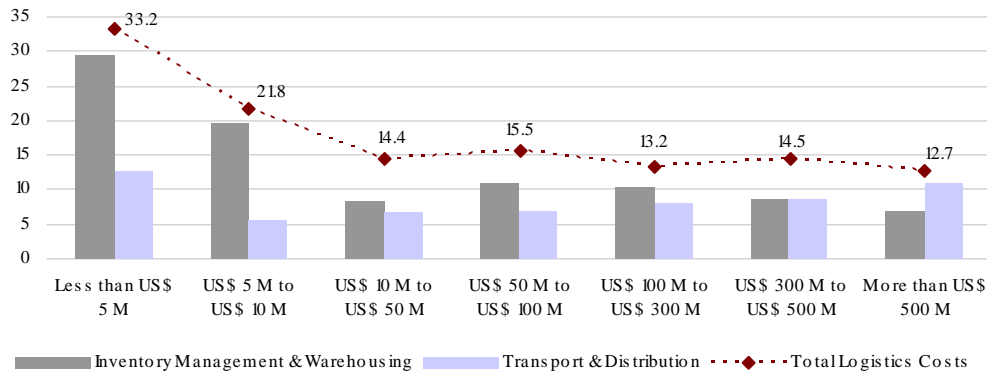
Source: Benchmarking 2007: Estado de la Logística en America Latina Anexo a la Presentación de Maria Rey LogisticSummit 2008

**Latin America: Average Logistics Costs by Component as % of Sales, depending on the Total Volume of a Company's Sales**



Source: Benchmarking 2007: Estado de la Logística en America Latina Anexo a la Presentación de Maria Rey LogisticSummit 2008

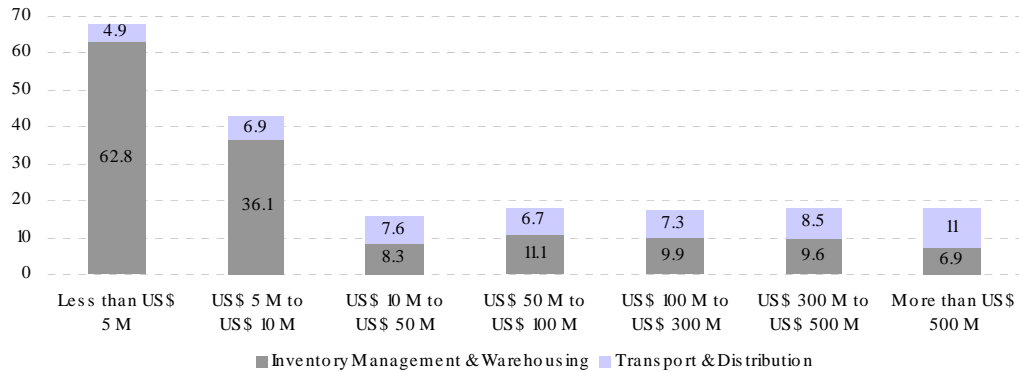
**Latin America: Average Logistics Costs by Component as % of Sales, depending on the Total Volume of a Company's Sales**



Note: "Total Logistics Costs" as a share of Sales does not always equal the sum of the two separate cost component shares, because not all firms in the sample reported on all logistics cost components.

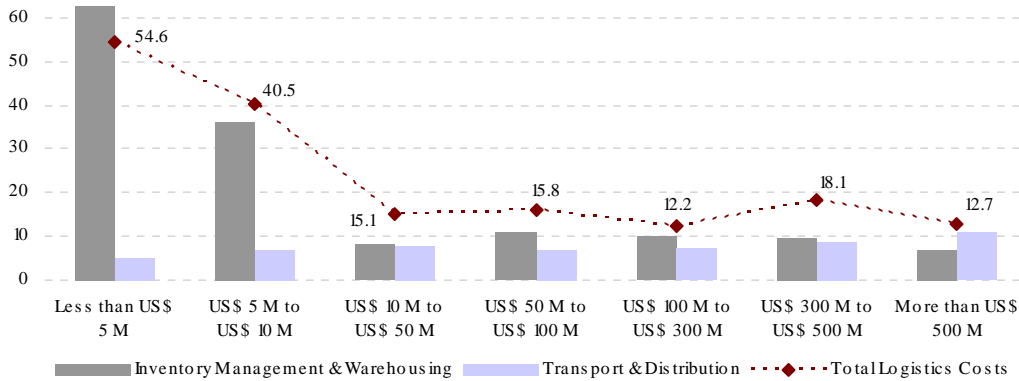
Source: Benchmarking 2007: Estado de la Logística en America Latina Anexo a la Presentación de Maria Rey LogisticSummit 2008

**South America: Average Logistics Costs by Component as % of Sales, depending on the Total Volume of a Company's Sales**



Source: Benchmarking 2007: Estado de la Logística en America Latina Anexo a la Presentación de Maria Rey LogisticSummit 2008

**South America: Average Logistics Costs by Component as % of Sales, depending on the Total Volume of a Company's Sales**



Note: "Total Logistics Costs" as a share of Sales does not always equal the sum of the two separate cost component shares, because not all firms in the sample reported on all logistics cost components.

Source: Benchmarking 2007: Estado de la Logística en America Latina Anexo a la Presentación de Maria Rey LogisticSummit 2008

## **Annex 8: Examples of Customs Reforms Initiatives Currently Underway**

This Annex provides synopses of several initiatives underway to modernize the region's national Customs agencies are currently underway.

For Mexico particularly important are the budget implications of the administrative efficiency and timeliness of Mexico's land border Customs, since they collect about 46% of the country's total Customs revenue; port Customs agencies, on the other hand, account for about 31% of the collections. A US\$63 million Customs modernization project launched in 2009 with World Bank support will improve the overall Customs efficiency by helping to increase the number of export/import declarations processed per human resource assigned and decrease clearance processing time. Applying an annual discount rate of 7%, the expected quantifiable benefits of the project include a 0.1% reduction in cargo costs for traders, a 0.5% decrease in the cost of imports due to faster cargo clearance, and another 0.1% cost decrease as a result of reduced clearance time *variability*. Finally, improved competitiveness due to Customs efficiency improvements is expected to increase Mexico's exports by 0.5%. The overall Net Present Value (NPV) of the project is estimated at US\$4 billion.

In Ecuador, an Institutional Reform project initiated in 2004 included a Customs Reform component aimed at improving control and streamlining of Customs processes. At a cost of US\$1.6 million, the Customs reform was expected to result in enhanced performance through decreased administrative costs per unit of output. The Customs reform overall was to allow for a more effective revenue management and a more effective monitoring, control and auditing of financial flows. The estimated fiscal benefit was a 10% daily increase in Customs revenue, in addition to other unquantified benefits like lower inventory requirements due to faster import clearance, lower costs of imports and exports, and reduced corruption.

In order to improve the international trade competitiveness of local companies, Brazil's Government in 2004 received World Bank support to implement a Sustainable and Equitable Growth program which included a US\$1 million component aimed specifically at simplifying the country's Customs clearance procedures, updating and integrating its computerized operations information systems, providing staff with adequate training, and improving arrangements for ensuring cargo security while maintaining operational efficiency. Part of the objective of the aforementioned procedures was to achieve full implementation of the *Mercosul* agreement for joint customs operations.

The Peru Trade Facilitation and Productivity Technical Assistance project (2003) focused on strengthening the intelligence and control capabilities of the Superintendencia Nacional de Administracion Tributaria (SUNAT). The project's Customs component - at a total cost of US\$7.3 million - financed such sub-components as software system development for airport Customs intelligence and the implementation, training and communication of risk management principles, and design and execution of communications and education programs for importers. The reduced logistics costs, combined with other objectives of the project, such as improvements in access to export finance, and adoption and implementation of effective quality practices, were hoped to help significantly increase Peru's exports, especially those of nontraditional products, in turn, reducing the country's vulnerability to commodity price fluctuations. According to earlier estimates of benefits from improvements in Customs services, Peru's exports in manufactures and agricultural goods could increase by US\$112 million if the transparency and professionalism of Customs and regulatory environments were improved by halfway up to the APEC average (10% increase).

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