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CLARIFYING TRADE COSTS: MARITIME TRANSPORT AND ITS EFFECT ON AGRICULTURAL TRADE

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ABSTRACT

Maritime transport costs have a significant impact on the trade in agricultural goods. Maritime transport costs represent a high proportion of the imported value of agricultural products -- 10% on average, which is a similar level of magnitude as agricultural tariffs. This study shows that a doubling in the cost of shipping is associated with a 42% drop in trade on average in agricultural goods overall. The tendency to source imports from countries with low transport costs is therefore strong. Trade in some products is particularly affected by changes in maritime transport costs, in particular cereals and oilseeds, which are shipped in bulk. Time spent in transit also has a strong effect on trade: an extra day spent at sea on an average sea voyage of 20 days implies a 4.5% drop in trade between a given pair of trading partners. Not only cost but also efficiency in getting agricultural goods to market are therefore important factors in explaining trade flows.

ACKNOWLEDGEMENTS

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Key words

Maritime transport, transport costs, shipping, agriculture, trade costs, agricultural trade, food exports, food imports.

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EXECUTIVE SUMMARY

This paper attempts to shed some light on how maritime transport costs affect trade in agricultural products. This study draws on a new dataset of maritime transport costs that has been compiled at the product level, by country of origin and destination. It is the most comprehensive dataset of its kind known today.

Maritime transport costs overall accounted for 10% of the imported value of traded agricultural goods in 2007. Transport costs vary widely, however, between different products and countries of origin and destination. It is cheaper, as a percentage of the imported value of the goods, to import to larger markets that are well connected to shipping lines than to small or less-developed markets.

The volatility in maritime transport costs in recent periods is a contributing factor to the recent sharp changes in prices of agricultural products. Other factors include uneven harvests, growth in demand for food in emerging economies, highly volatile oil prices, medium and long-term agricultural policies and the use of some agricultural land for the production of biofuels.[1] Shipping costs of some staple agricultural products such as grains are particularly high. Shipping grains to smaller markets such as lower income countries and some net food importing developing countries is particularly expensive, comprising up to 20-30% of their imported value in some cases. There are a number of reasons for the high shipping costs to some of the developing countries in the study – a large proportion of bulky raw materials such as grains, and remoteness from main agricultural exporters are two examples that are confirmed in the analysis.

On average, the cost of shipping grains to least developed countries and net food importing developing countries covered in the dataset increased more than two-and-a-half times (150%) from 2002 to 2007 measured in cost per weight. Preliminary figures for the first half of 2008 show an even sharper increase – up to 250% in some cases, followed by a sharp drop in shipping costs to 2003 levels in some cases. The situation is similar in many other developing countries. Although price transmission is imperfect, the effects of this increase can be severe since in some of these countries more than half of the average household budget is spent on food.

Transport costs are on average more widely dispersed than tariffs on agricultural goods. This means that transport costs are much more differentiated between different countries of origin and destination and different products than are tariffs.

The econometric estimation undertaken for this study shows that a doubling of bilateral transport costs is associated with a 42% decline on average in the value of bilateral country-pair agricultural imports overall, ceteris paribus. This strong effect implies that producers in countries which have high transport costs suffer significantly in terms of the amount of goods they trade. The tendency to source imports from countries with low transport costs is therefore strong.

1. This question has been addressed in a comprehensive fashion in OECD-FAO(2008 and 2009).

In addition to the strong effect of the cost of maritime transport on trade, the efficiency of getting goods to market is very important. A decrease in the time spent at sea of one day on the average sea voyage of 20 days implies an increase in trade of 4.5%.

The impact of transport costs on trade in different product groups is wide-ranging. The impact of a doubling of transport costs on any given product is to decrease its trade by 18%, on average. Tariffs are also shown to have a negative effect on trade.

The impact is particularly strong on agricultural products that are transported in bulk, in particular cereals. A doubling of the transport cost of exporting cereals between two given countries implies a 37% decrease in their trade. Other product groups that are particularly affected by changes in transport costs such tropical export products as sugar, cocoa as well as prepared meat and fish and oils and fats. Given the finding that transport costs vary greatly between countries and over product groups, it is necessary to analyse more precisely what factors impact the level of shipping costs. A companion paper, *Determinants of Maritime Transport Costs in Agriculture* (forthcoming), examines this question and sheds some light on the importance of different factors such as trade volumes, trade imbalances, time spent at port, competition on the shipping route and fuel costs on the level of maritime transport costs in agricultural products.

CLARIFYING TRADE COSTS: MARITIME TRANSPORT AND ITS EFFECT ON AGRICULTURAL TRADE

Introduction

1. The recent dramatic changes in agricultural commodity prices has attracted great attention. There are many reasons for price increases: uneven harvests, growth in demand for food in emerging economies, highly volatile oil prices, medium and long-term agricultural policies and the increasing use of some agricultural land for the production of biofuels. Transport costs have risen sharply in recent years for some products, exacerbating the situation of some net food importers. [2] Following a strong supply response, agricultural commodity prices have fallen sharply since the second half of 2008. In line with the economic slowdown, maritime transport costs have fallen as well.

2. Maritime transport matters. Ninety percent of merchandise trade by volume is transported to market by ship. Maritime traffic in 2007 was almost double its 2003 level. Operation of merchant ships now generates an estimated annual income approaching US$380 billion, equivalent to about five percent of total world trade.

3. The cost of maritime transport is particularly high for some agricultural products. For some countries, the cost of importing grains reached 20-30% of their total value in 2008. This may be compounded by an additional overland cost of transport. In addition, since many basic agricultural products are already subject to significant tariffs, their high transport costs further decrease potential for trade and increase costs to consumers. These high costs have exacerbated the food supply situation in some net food importing countries.

4. Maritime transport costs vary widely between commodities and trade routes. They also differ depending on the segment of the shipping market that is delivering the goods. Agricultural products are shipped in different ways – in containers for some products, or by bulk transporters for grains and some oilseeds. Transportation costs in these two maritime transport sub-markets are only imperfectly correlated and often account for very different shares of the final import cost of goods.[3] Generally, goods shipped in containers are found to have lower transport costs per tonne of merchandise shipped, as are those on well-travelled trade routes between major ports.

5. The aim of this paper is to shed light on how maritime transport costs affect trade in agricultural products. In order to improve the analysis of the impact of transport costs on trade, a new dataset has been compiled from a variety of sources. A full explanation of the new dataset used in the analysis here can be found in OECD, *Clarifying Trade Costs in Maritime Transport*(forthcoming). This is the most comprehensive dataset on maritime transport rates known to date and includes up-to-date original customs data as available and detailed data estimated from shippers' actual rates. The data set now compiled includes about four million data points for products at the HS-6 digit level for 42 importing countries from all 218 countries of the world from 1991 to 2007.[4] A subset of this dataset,

2. Jacques Diouf, Director General of FAO, indicates the importance of the rise in maritime transport costs on current high food prices in a recent interview with the Financial Times: http://media.ft.com/cms/s/2/f5bd920c-975b-11dc-9e08-0000779fd2ac.html?from=foodcrisis

3. An overview of the main issues affecting the maritime transport sector and its impact on trade flows can be found in OECD, *Clarifying Trade Costs in Maritime Transport (forthcoming*).

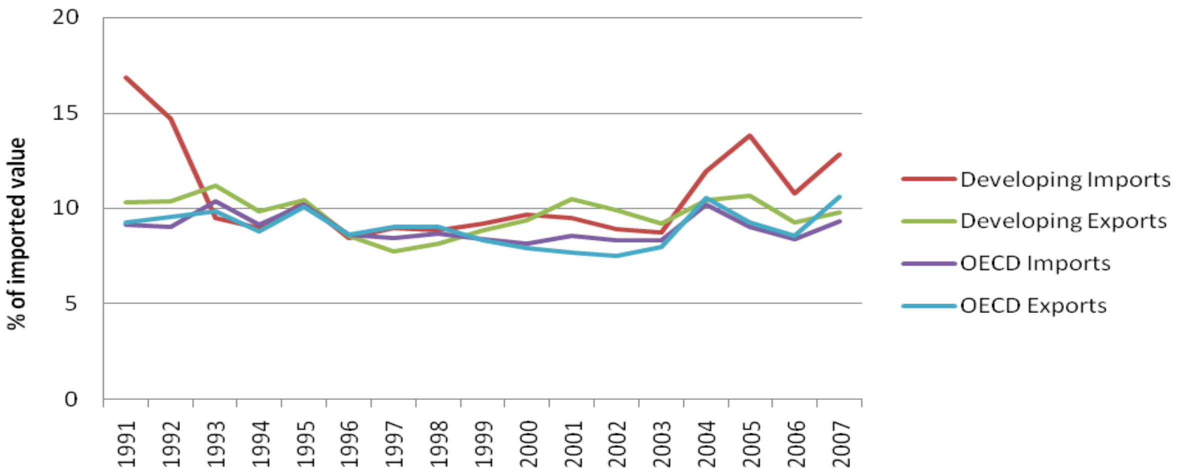
4. Due to the size of the dataset, zero trade flows are not included. Adding zero trade flows to this already extensive dataset would make any analysis too unwieldy. Omitting zero trade flows from the dataset

including transport costs and trade flows in agricultural products, was used for the analysis in the present paper. [5] The seabourne agricultural imports included in this dataset represented 27% of total agricultural imports (by all modes of transport) in 2007.

Level and progression of maritime transport costs

6. Maritime transport costs overall accounted for 10.3% ad valorem of the imported value of traded agricultural goods in 2007. Transport costs vary widely, however, between different products and different countries of origin and destination. It is generally cheaper to import to and export from larger markets that are well connected to shipping lines than to and from small or less-developed markets. It is significantly less expensive, in ad valorem terms, to import food and other agricultural goods into OECD countries as compared with developing countries.[6] On average, OECD agricultural imports faced transport costs of 9% in 2007 whereas imports to developing countries of agricultural goods from all destinations were subject to maritime transport costs of 13% ad valorem (Figure 1).

Figure 1. Ad valorem transport costs in agricultural products



Source: OECD Maritime Transport Cost database.

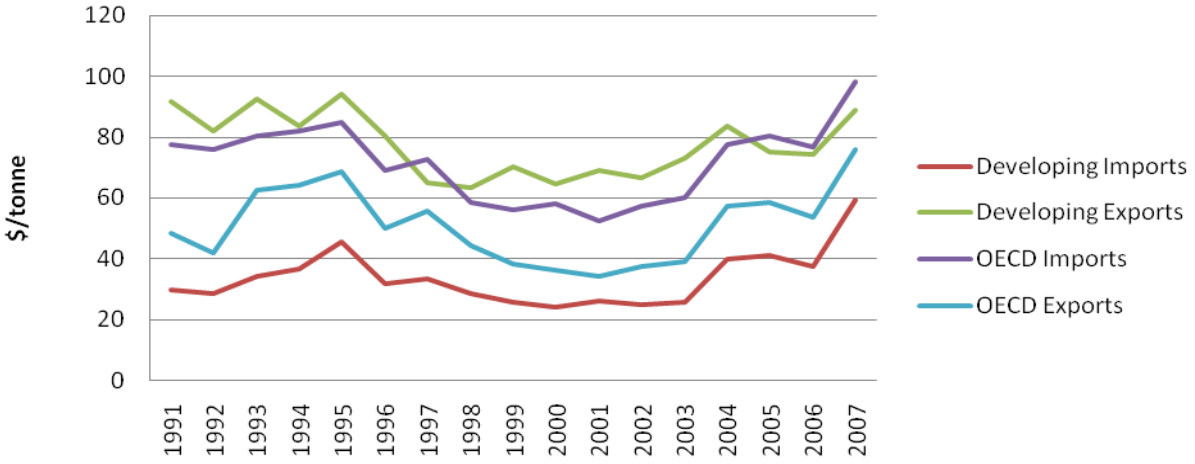
7. Shipping costs are therefore higher into developing countries than into OECD countries on average as a percentage of the value of the goods imported. This is not, however, due to higher costs of shipping a ton of merchandise. Examining more closely the cost of transporting a tonne of agricultural merchandise (as opposed to the percentage of the value of the goods shipped), it is found that the lowest cost of transport is that for developing country imports (Figure 2). The high cost of importing into developing countries in the dataset, *as a proportion of the import value*, is therefore due to the fact that many of the developing countries in the dataset import large amounts of grains, which are voluminous and expensive to transport due to their low value to weight or value to volume ratio. The high cost ad valorem of importing to non-OECD countries in the dataset is therefore due in greater part to the product composition of their imports—lower value added, more voluminous products – than to higher relative shipping prices (Figure 2).

underestimates the potential impact of the explanatory variables on trade. The model results expressed here can therefore be considered lower bound estimates.

5. Agricultural products include all those in HS classification 01-24.

6. For countries included in the dataset. See Appendix Table 1 for data availability.

Figure 2. Cost of transporting a tonne of agricultural goods



Source: OECD Maritime Transport Cost database.

8. Maritime costs have increased by 26% in terms of cost of shipping a tonne of agricultural products on average over the period from 1991 to 2007 for all countries in the dataset (subject to data availability, see Appendix Table 1). This is despite significant improvements in technology – larger, faster ships for example, increasing economies of scale, and generally more competitive environments due in part to the disbanding of shipping conferences.[7] Transport costs have risen slightly in ad valorem terms over the 16-year period, presumably due in part to increases in the value-to-weight ratio of goods shipped.

Maritime transport costs across regions

9. Maritime transport costs vary significantly by region. Regarding imports into the United States, there is a strong regional component to maritime transport costs, measured as cost per weight. Maritime costs are lowest for some of the regions that are geographically closer – the Caribbean and South America – and highest for the countries of Oceania, Middle East and North Africa and Europe, followed by Asia and Africa. In 2007, maritime rates varied across regions, from just over USD 60 per tonne of merchandise for imports from Caribbean countries to USD 140 per tonne for countries from Oceania (Figure 3).

10. When regarding maritime transport costs measured as a share of the value of the traded goods, the picture is quite different. In this way, maritime transport costs are largely determined by the types of goods that are traded. Measured as cost ad valorem, shipping costs are highest into the US market from South America where they represent 10% of the value of the traded goods (Figure 4). Shipping rates from all other regions of the world are between 5.5 and 7.5% in 2007. This is probably due largely to the content of the agricultural trade. South American countries export more bulk agricultural goods, in particular grains, as opposed to more processed products and higher value added goods from some other regions.

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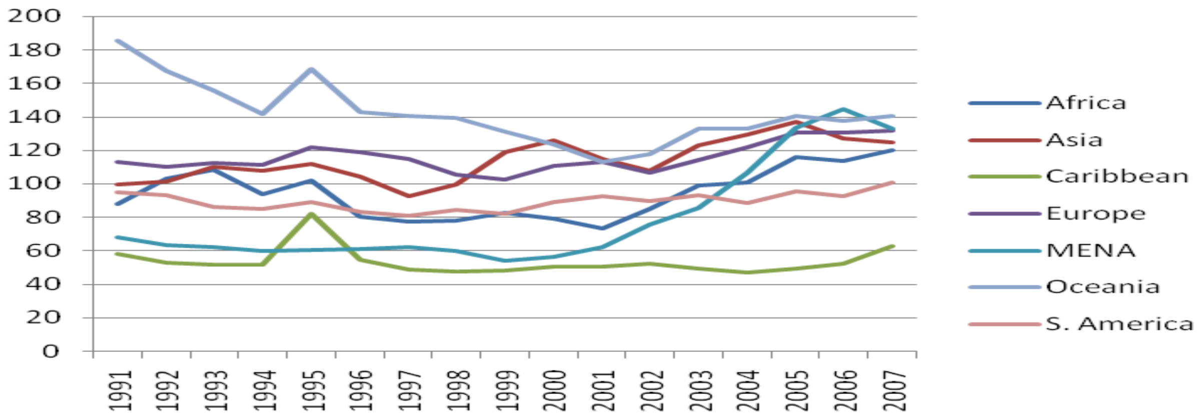
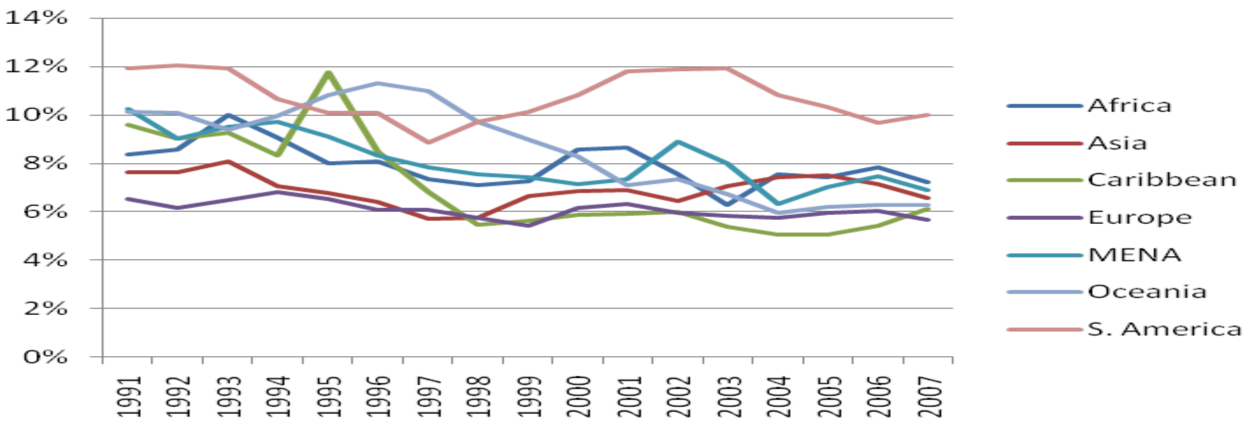
7. For a fuller discussion of changes in the shipping industry, see OECD, *Clarifying Trade Costs in Maritime Transport (forthcoming)*.

Figure 3. Maritime Transport Costs of US Agricultural Imports by Region, USD/tonne



Source: OECD Maritime Transport Cost database.

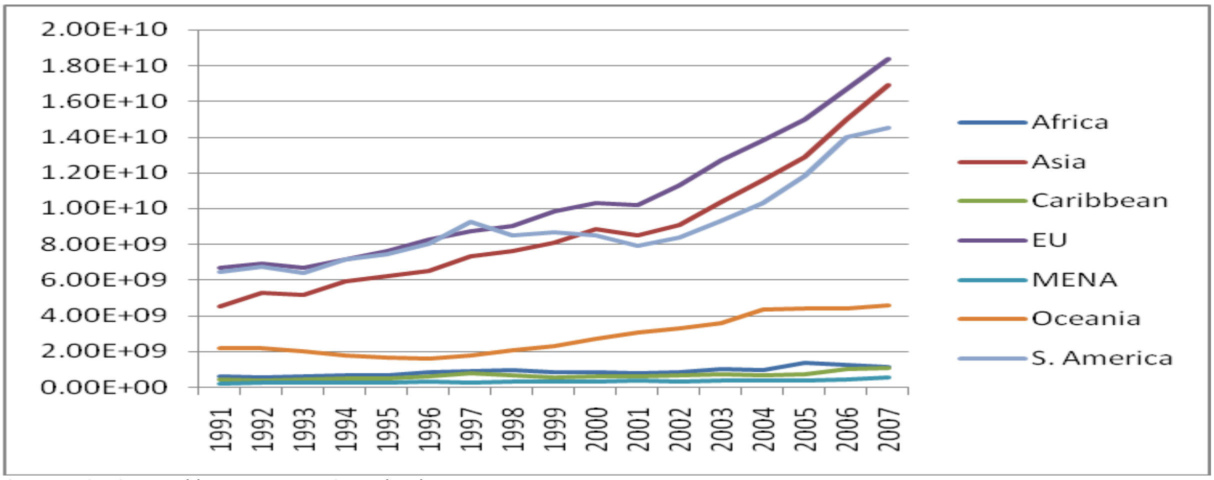
Figure 4. Maritime Transport Costs of US Agricultural Imports by Region, Ad Valorem



Source: OECD Maritime Transport Cost database.

11. The high transport costs, whether measured in cost per weight or in ad valorem equivalents, have not however proven prohibitive for trade. Over the 16-year period covered in this study, agricultural imports from Asia, Europe and South America to the United States have increased strongly from between USD 4 and USD 7 billion to between USD 14 and 19 billion US$ for each region in 2007 (Figure 5). US seaborne imports of agricultural goods from Asia were multiplied by four over the 16-year period, those from Europe increased two and a half times, and those from South America doubled. The high transport costs faced by potential exporters on these continents therefore did not prove to be a prohibitive barrier to trade with the United States.

Figure 5. Total Value of US Imports of Agricultural Goods by Region



Source: OECD Maritime Transport Cost database.

Maritime transport costs and the recent volatility in the prices of traded staple foods

12. The World Bank (2008) estimated that food prices rose by an average of 83% between 2005 and 2007, with world prices of maize, wheat and oilseed crops nearly doubling in nominal terms (OECD-FAO, 2008). Examples of the effects of rising food prices are numerous. Food riots broke out in Yemen, Morocco, Mexico, Senegal, Guinea, Haiti, Philippines, Mauritania and Uzbekistan. Pakistan reintroduced rationing while Russia froze the price of some staple foods. Indonesia increased public food subsidies, and India among others banned the export of rice, excluding the high-quality basmati variety. In Bangladesh, the price of rice increased by one-third in the last year, inciting strikes among garment workers in Dhaka.[8]

13. There were a number of important factors in the sharp rises in agricultural commodity prices, namely poor harvests, growth in demand for food in emerging economies, policy changes among some major exporters, changes in exchange rates, speculation, higher oil prices and the use of some agricultural land for the production of biofuels. The increase in maritime transport costs was an additional factor that contributed to steep rises in agricultural commodity prices. In the least developed countries (LDCs) and net food importing developing countries (NFIDCs) in the dataset, maritime transport costs of cereals, expressed in cost per weight, increased more than two-and-a-half times (150%) between 2003 and 2007 (Figure 6). Figures for the first half of 2008 indicate that shipping costs to LDCs and NFIDCs rose by close to 250% between 2003 and 2008. By 2009, however, shipping costs had fallen to 2003 levels, representing a 60% drop in some cases.

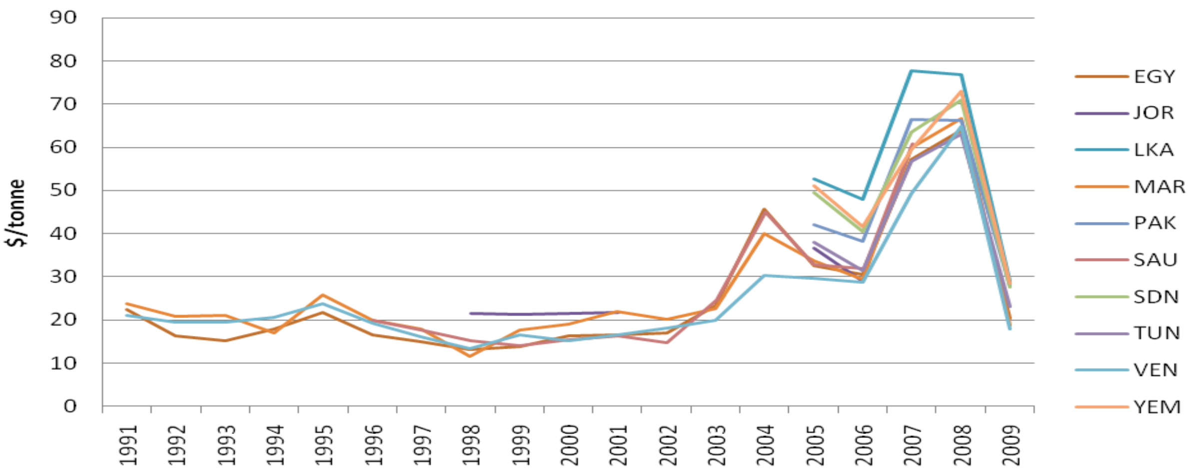
14. The situation is much the same in other developing countries. Although not among the least developed economies, countries such as Bangladesh, Algeria, Colombia and Iran import a significant proportion of their populations' food supply, and expenditures on food take up a large part of household budgets. In Bangladesh for example over half the average household's budget is spent on food.[9] Recent sharp rises in the cost of shipping grains, and therefore increases in the prices of cereals, strongly

8. *Food crisis could slow growth, says UN chief*, The Guardian, www.guardian.co.uk, April 21, 2008; *Emeutes de la faim : un défi inédit pour l'ONU*, www.lemonde.fr, April 14, 2008; *L'Asie menace d'une crise alimentaire*, www.lefigaro.fr, April 2, 2008; *Countries rush to restrict trade in basic foods*, www.ft.com, April 2, 2008.

9. USDA/ERS, International Food Consumption Patterns, http://www.ers.usda.gov/Data/InternationalFoodDemand/.

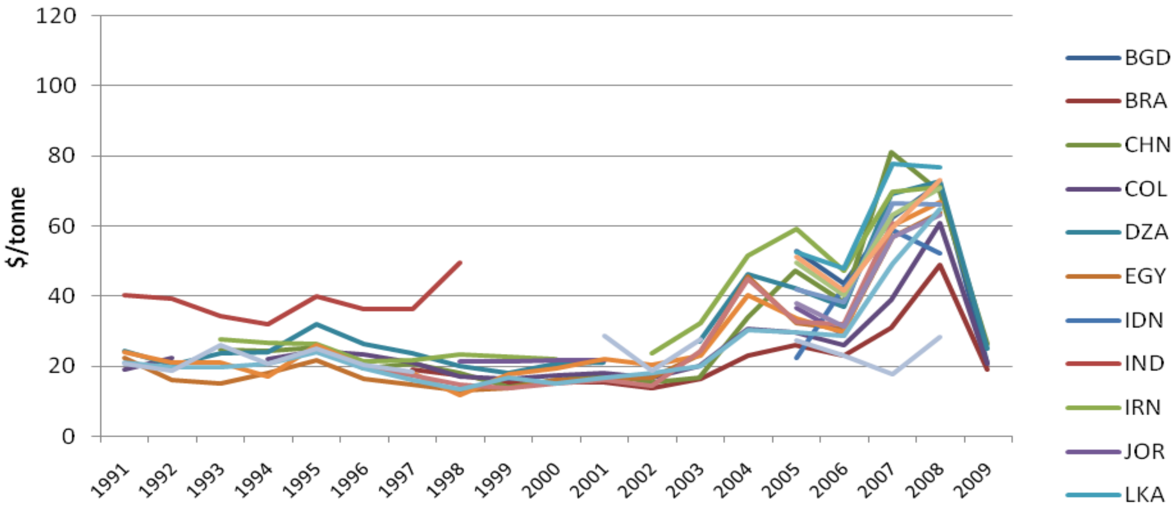
affected many households in these countries. The cost of shipping grains to the selected other developing countries (*i.e.* non-OECD, non-LDC and non-NFIDC) in the dataset rose by more than 150% between 2003 and 2007 for many countries, expressed in cost per weight (Figure 7), followed by a very sharp fall in shipping rates in early 2009 back to 2003 levels.

Figure 6. Cost of importing a tonne of grain from major exporting countries to lower-income developing countries[10], USD/tonne



Note: 2009 figures refer to January-March.
Source: OECD Maritime Transport Cost database.

Figure 7. Cost of importing a tonne of grain from major exporting countries to selected other developing countries[11], USD/tonne



Note: 2009 figures refer to January-March.
Source: OECD Maritime Transport Cost database; International Grains Council (2009 figures).

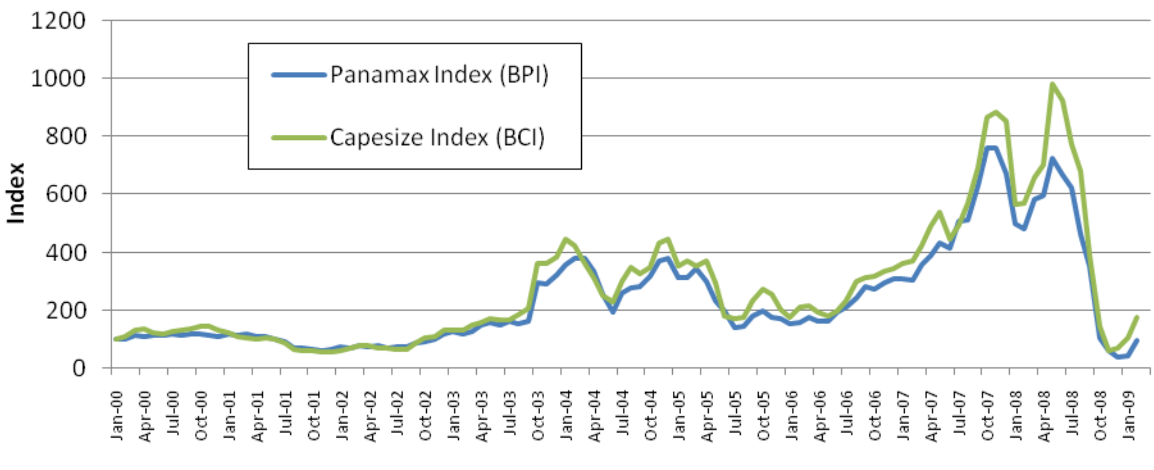
10. Countries included in Figure 6 are LDCs and NFIDCs, as defined by the United Nations, which figure in the dataset.

11. Countries included in Figure 7 are all developing countries in the dataset with the exception of LDCs and NFIDCs, as defined by the United Nations.

15. In the second half of 2008 and early 2009 agricultural commodity prices fell substantially from the peaks attained in mid 2008, a trend that is forecast to continue through 2010. Prices for wheat and rice illustrate this phenomenon. The price of wheat rose by 66% in crop year 2007-08 compared with 2006-07; whereas prices in crop year 2008-09 fell by 23% and are expected to fall by another 20% in 2009-10 (OECD-FAO, 2009). Rice price changes are similar although price changes are recorded on a calendar year basis therefore the steep declines that started in mid-2008 figure differently. Rice calendar year prices rose by 70% in 2007 and 17% in 2008 due to continued rising prices in the first half of the year. The price of rice is expected to decline in 2009 by about 35% (OECD-FAO, 2009). It should be kept in mind that the declines in agricultural commodity prices since late 2008 are from historically high levels.

16. While the prices of grains were experiencing sharp rises and steep declines, the transport costs of these goods were evolving in a similar way. Grains are transported in bulk on very large (Capesize) ships to and from major grains markets and on smaller (Panamax) ships to smaller markets. The indices of the cost of shipping in these different size ships illustrate the extreme fluctuations in grain shipping costs (Figure 8). Indices of both ship sizes, which track the bulk shipping market, exhibit strong volatility, even on a month-to-month basis. The concomitant sharp declines in prices of basic foods and in the cost of their transport are on the one hand due to the general macro situation – fall in demand, fall in the price of oil, potentially less capital to invest and speculate, anecdotal evidence of generally risk averse behaviour, etc. – and on the other hand in part due to each other. The price of transport has fallen in part due to lower demand for food, and food prices have fallen in part due to lower transport costs. It should be noted, in addition, that the cost of hiring a Panamax vessel, *i.e.* to ship grain to and from smaller markets, is somewhat less volatile than that for large vessels.

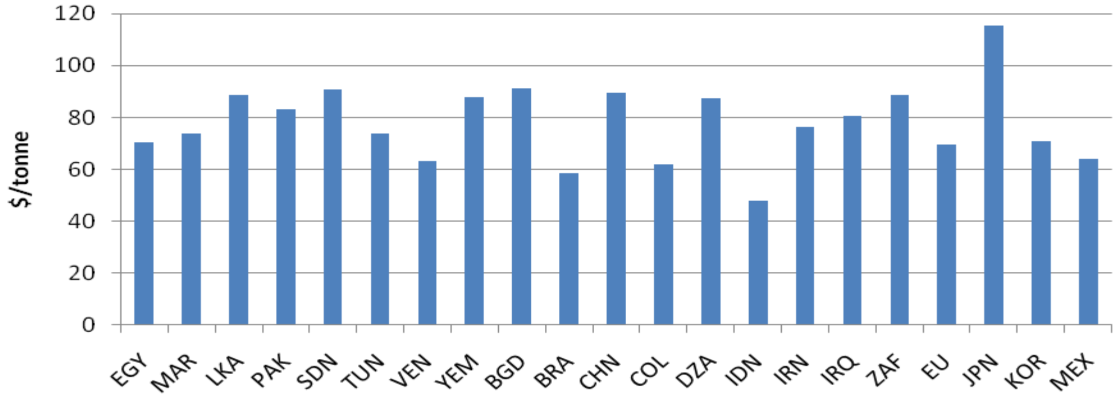
Figure 8 . Cost of shipping grains, composite indices



Note: For both BPI and BCI, January 4, 2000 = 100.
Source: The Baltic Exchange.

17. It is comparatively more expensive to ship grains to smaller markets in developing countries. Shipping costs per ton of imported grain were between USD 80 and 100 per ton in many developing countries in the first three quarters of 2008 (Figure 9). The cost of shipping grain to some developing countries is particularly high: Algeria, Bangladesh, China, Iraq, Pakistan, Sudan, Sri Lanka, South Africa and Yemen are greater than or equal to USD 80 per tonne.

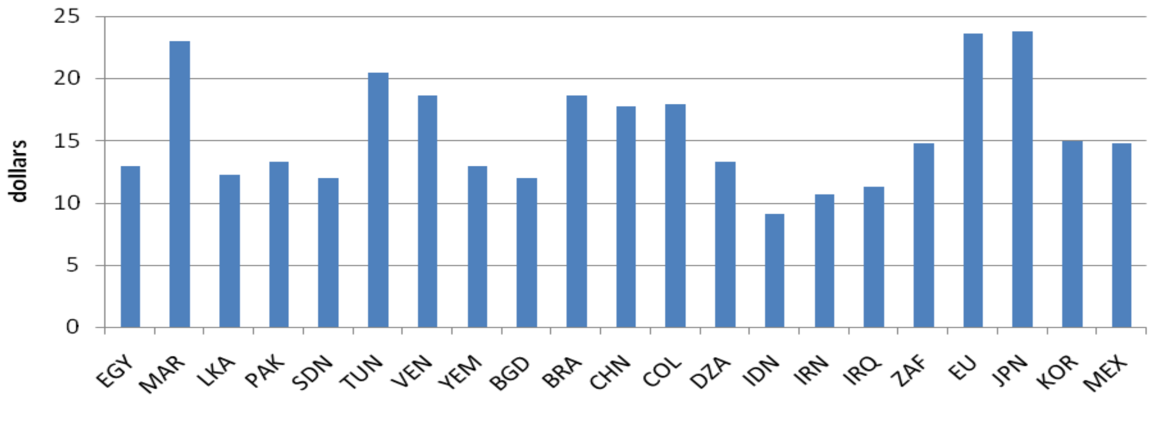
Figure 9. Cost of shipping one tonne of grain to selected countries from major markets, USD/tonne, 2008



Note: Figures refer to January-August 2008.
Source: OECD Maritime Transport Cost database.

18. There could be many reasons for higher transport costs into less developed countries: less competition on the shipping route; more time spent unloading cargo at portside, which is in turn factored into the price of shipping; large imbalances in trade on some routes; or some countries simply being farther from the major exporters. In fact, evidence points to the latter reason in the case of grains exports to many LDCs and NFIDCs. When distance is factored into the analysis, the less developed countries are not the most disadvantaged in terms of cost of shipping a given weight. When transport costs (in USD/tonne) are transformed into transport costs in USD per tonne of merchandise transported 1 000 nautical miles, *i.e.* the distance component is accounted for, the poorest developing countries do not pay more for having goods shipped than other countries (Figure 10). This indicates that the higher shipping costs of grains to the poorest developing countries are principally due to their remoteness from major grains exporting countries.

Figure 10. Cost of importing grains from major markets, USD per tonne per 1000 nautical miles, 2008



Note: Figures refer to January-August 2008.

Source: OECD Maritime Transport Cost database for maritime transport costs; maritimeChain.com for actual shipping distances in nautical miles.

Mean and dispersion of maritime transport costs in agricultural and non-agricultural goods

19. There has been a growing interest in measuring trade costs because of a real or perceived decline in other trade barriers, such as tariffs, and increased competition among exporters that has generally had a downward pressure on exporters' margins. Tariffs have fallen considerably over past decades, particularly as regards non-agricultural goods, whereas transport costs have risen slightly overall in ad valorem terms over the time period covered comprehensively in the dataset – 1991 to 2007.

20. Maritime transport costs, while comparable in value to tariff levels for agricultural products, remain more highly dispersed. Agricultural tariffs for importing countries included in the dataset average 10.1% overall, compared to a mean of 10.3% for agricultural maritime transport costs (Table 1).[12] Their standard deviation, however, is much higher – maritime transport costs measured as a percent of the value of imported goods vary greatly between products and countries of origin and destination – nearly twice as much as do tariffs. Transport costs are also more highly dispersed than tariffs as regards non-agricultural goods (over three times more), indicating that the large deviation in maritime transport costs is in no way linked to the nature of the goods.

Table 1. Maritime transport costs in agriculture are more highly dispersed than tariffs

% ad valorem and standard deviation

	Mean	Standard deviation
Transport	10.3	44.4
Tariffs	10.1	27.0

Note: Figures refer to all products and countries of origin and destination in the dataset, from 1991-2007. See data availability in Appendix Table 1 for exact coverage.
Only those products for which tariff rates are available are included. Means may therefore not correspond to those included elsewhere in this paper as they are calculated from a smaller dataset. Transport cost means are ad valorem. Tariff means are calculated from simple average tariffs,. Tariff rates are not integrally accounted for, particularly as regards specific tariffs and TRQs and should therefore be regarded only as indicative.

Source: OECD Maritime Transport Cost database; WITS/Trains for tariff data

Quantifying the effect of maritime transport costs on bilateral imports of agricultural products

21. This section presents the results of the econometric analyses quantifying the effect of maritime transport costs on bilateral imports of agricultural products. The new maritime transport cost dataset analyzed above will be used to answer the following main questions.

- How do differences in maritime transport costs affect agricultural exports and imports?
- Once transport costs are controlled for, what is the impact of other factors such as the size of importing and exporting economies, distance, time at sea, tariff levels and the adherence to a regional trade agreement?
- Are some product groups' trade more sensitive to changes in maritime transport costs? If so, which ones?

22. An augmented gravity model has been constructed in order to shed light on these questions. In the traditional gravity model, country GDP captures economic mass and distance is a proxy for trade costs. In the empirical literature on trade determination, the distance measure captures transport costs,

12. Figures may not correspond exactly to those included elsewhere in this paper as they are calculated from a smaller dataset using only those products for which tariff rates are available and they refer to simple averages.

and all other trade costs, as well as other potential barriers such as cultural distance, business networks, unfamiliarity and, increasingly, time. The gravity equation is typically augmented by other variables that serve as proxies for a variety of trade costs and other barriers to trade – for example, geographic variables, cultural variables, regional trade agreements and tariffs. Given the empirical regularity of the relationship between distance, GDP and trade, interest usually lies in quantifying the impact of particular policy variables.[13]

23. Gravity models should be viewed as measuring the effect of a given variable (in this instance the effect of changes in bilateral transport costs) on the trade of an "average" country pair. Results cannot necessarily be generalised to the case where transport costs of all country pairs in the data set rise or fall by a similar amount. In this case, substitution will occur between countries of origin (and, potentially, modes of transport) which will in turn impact prices and quantities – and to account for all these changes, a general equilibrium context with explicit substitution of outputs and inputs is required.

24. The OECD Maritime Transport Cost database allows us to model the empirical relationship between trade costs and the value of imports more accurately by accounting for the transport cost component of distance explicitly. By explicitly allowing freight charges to impact trade, we are able to measure the size of the transport cost barrier while allowing the distance variable to capture some of the remaining components of trade costs. To the extent that distance has been found to be a poor proxy for transport costs (Hummels, 2001), modelling imports as a function of freight charges as well as distance and other trade determinants, should shed light on their importance in determining trade flows and the extent to which priority should be given to lowering these trade costs for the countries exhibiting the highest levels – most notably developing economies. The structure of the database allows us to investigate the relationship between maritime transport costs and trade over time while the highly disaggregated nature of the data allows a thorough examination of the variation in transport costs across commodities as well as their impact on the volume and value of imports of that commodity. Our analysis contributes to the growing body of work which examines trade flow data at a highly disaggregated level.[14]

25. Several model specifications have been estimated, using both aggregated and disaggregated data restricting the analysis to agricultural goods, that is, all commodities included in Harmonized System classification (HS) 01-24. A single observation in the disaggregated data consists of the nominal value of seaborne agricultural imports in commodity k transported by sea from exporter j to importer i in period t measured in current US dollars. The data includes all importing and exporting countries covered in Appendix Table 1. For the aggregated data, an observation refers to the total nominal value of seaborne agricultural imports from exporter j to importer i in each period. The dataset spans from 1991 to 2007 and is available at the 6-digit product level of the Harmonised System. We use an augmented gravity equation, explicitly accounting for transport costs which in the analyses are modelled as transport cost per tonne. Data are obtained from the OECD Maritime Transport Cost database described in *Clarifying Trade Costs in Maritime Transport*(forthcoming). The gravity model includes the following control variables: GDP for importer measured in current US dollars; agricultural GDP of the exporter;[15] a common language dummy equal to one if the country pairs share a common official language; an indicator to capture whether the countries have ever had a colonial link; in some

13. See the technical appendix for a more detailed description of the gravity model used here and corresponding econometric analysis.

14. For example, Harrigan and Deng (2008) and the references therein, Harrigan (2006), Hummels (2001), Martinez-Zarzoso *et al*. (2007) among others.

15. In most specifications we model GDP as the product of exporter Agricultural GDP and importer total GDP.

specifications an indicator to capture the presence of a major regional trading agreement; whether the countries have an access to each other by land; tariffs and shipping time or shipping distance.

26. In order to address the empirical questions above, two categories of models were estimated: the first category, Models 1 – 4 in Table 2, estimate the relationship using aggregate data and model agricultural import demand as a function of maritime transport costs. The second category, Models 5 to 9, estimates the relationship using disaggregated data. In order to compare model results incorporating maritime transport costs explicitly with a simple gravity model similar to those used in much of the literature, Models 4, 7 and 8 exclude transport costs to estimate a simple gravity equation on both the aggregate and disaggregated imports. Results from estimating all of these models are presented in Table 2. The relationships were also estimated at the level of the product group (HS 2-digit) where trade was modelled as a function of transport costs, as well as all the other gravity variables. These results are included in Appendix Table 2. It is probable that the models we have specified suffer from simultaneity bias since there is likely to be reverse causality between transport costs and the value of imports. To address this source of bias, we estimated all models using two stage least squares and instrumented transport costs with the import value to weight ratio.

Estimated impact of maritime transport costs on trade

27. At the aggregate level results show that a doubling of bilateral maritime transport costs (USD/tonne) is associated with between 42% and 43% decline in the value of agricultural imports between two given countries, holding constant the effects of importer GDP and exporter Agricultural GDP, time at sea, distance and the other determinants of agricultural imports (Table 2, Models 1, 2 and 3).[16] The model results are based on data prior to mid-2008 and therefore do not include the economic changes that resulted from the global economic crisis that started at that time. All indicators fell sharply in end-2008, continuing in 2009, including maritime transport costs, trade, and GDP. The results in this model should be interpreted *ceteris paribus*, or other things being equal. During a crisis period when GDP and other macro indicators are falling sharply it is more difficult to ascertain the impact of explanatory variables such as transport costs, on trade as other important factors are rapidly changing.

28. Distance continues to have a strong effect on agricultural trade flows, even accounting explicitly for maritime transport costs. This is consistent with recent literature (*e.g.* the meta-analysis included in Disdier and Head, 2008). The estimated coefficients on the distance variable suggest that a 10% increase in distance between trading partners leads to a more than proportional fall in agricultural imports of 12% (Table 2, model 1). This result confirms that the distance variable in the gravity model captures much more than just maritime transport costs. This also provides evidence that by including accurate transport cost data in our models, we can in fact extract the transport cost component of the distance variable, allowing it to capture other barriers to bilateral trade. Some of the impact of distance is captured by transport costs, as can be observed when comparing models including transport costs with those that omit transport costs explicitly (as do most gravity models used in the trade literature). When transport costs are omitted from the model, a 10% increase in distance results in a 16% drop in agricultural trade flows (model 4).

29. An alternative to using distance in the measure of transport costs is to use average time at sea. This variable, strongly correlated with distance, is a closer indicator of the time cost that is extremely important to exporters. Using this preferred model specification, the impact of maritime transport costs remains high – a doubling in transport costs implies a 42% decrease in agricultural trade between a given pair of countries, other things being equal (model 2). The impact of time spent at sea is also highly

16. For a large change in transport costs the estimated impact is calculated as $\Delta trcost^{\beta} - 1$. See paragraph 25 above for a discussion of the interpretation of gravity model results.

significant, with a coefficient of -0.902. This implies that a decrease in time spent at sea of one day on the average sea voyage of 20 days would increase trade by 4.5%. The impact of time spent at sea is, however, decreasing slightly over time (the interaction term of time at sea with time in model 3 is small but significant and negative).

30. Results modelling the impact of transport costs on disaggregated agricultural imports, *i.e.* at the HS 6-digit product level, find that the impact of maritime transport costs on trade is lower than that in the aggregated models. In the disaggregated analysis, a doubling of bilateral transport costs per unit leads to a decrease in imports of a typical bilateral country pair and a given typical product of between 18 and 19% (Table 1, Models 5, 6 and 9). Consistent with other studies, importer GDP has a large positive impact where a 10% increase in importer GDP on average leads to a 7% increase in agricultural trade (model 9).[17]

31. The estimated effect of distance has changed substantially however compared to the models using aggregated data: a 10% increase in distance now only reduces imports by between 3 and 7%. This result is intuitively appealing since it would be expected that distance impacts more heavily on total imports rather than single commodities in this highly disaggregated data — single commodities represent small proportions of the total and their trade at the product level depends on many other, potentially more important factors. As in the aggregated models, the distance coefficient is lower when the transport costs are included in the equation as compared with models in which they are not included (distance coefficient of -0.72 in model 8 as opposed to -0.61 in model 5).

32. In the model specifications at the product level, the importance of time at sea is confirmed. A decrease in time spent at sea of one day on an average voyage of 20 days implies an increase in trade of between 1.6 and 2.5%.

33. The impact of tariffs on agricultural trade flows is small and statistically significant: a one percentage point increase in the average tariff rate will see a decline in imports of approximately 0.06% (Table 2, Model 7).[18] There may be numerous reasons for this small effect: tariffs are not completely accounted for in the data, some major agricultural trade is in products that are subject to TRQs which are difficult to model in this general context, tariffs are combined with other non tariff measures, or are correlated either with phenomena not measured here, or with transport costs themselves. Additionally, tariffs refer to MFN tariffs by importing country, and there is therefore no differentiated effect by country of origin. This result does help to confirm some of the recent literature that underlines the lessening importance of tariffs, even in agricultural goods, as opposed to the large impact of, for example, non tariff measures (not included in the present model) or transport and logistics costs.

34. An alternative measure of tariff levels to the average ad valorem tariff rates described above is the number of international tariff peaks. An international tariff peak is defined as any tariff higher than 20%. Tariffs measured using this indicator also decrease trade flows. The coefficient on this indicator of tariff peaks is significant and negative (model 8) although its magnitude is difficult to interpret.

17. The measure of GDP used for the agricultural exporters is in fact the total agricultural GDP in order to capture the potential for export of agricultural products. For importers, the measure of GDP used is the total GDP since this better captures the potential consumption of agricultural goods (*i.e.* the “economic mass” in gravity model terms).

18. Tariffs are modelled as *log (1+tariff rate)*.

Table 2. Impact of transport costs and other variables on trade in agricultural products

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
trcost	-0.812***	-0.794***	-0.793***		-0.293***	-0.280***			-0.298***
	(0.038)	(0.047)	(0.046)		(0.008)	(0.009)			(0.013)
distance	-1.181***			-1.582***	-0.609***		-0.278***	-0.720***	
	(0.046)			(0.044)	(0.012)		(0.013)	(0.012)	
colony	0.855**	1.541***	1.533***	1.077***	0.842***	0.974***	0.592***	0.844***	1.347***
	(0.274)	(0.318)	(0.318)	(0.285)	(0.044)	(0.047)	(0.059)	(0.044)	(0.138)
land	-1.080***	-1.023***	-1.028***	-0.937***	-0.734***	-0.655***	-0.363***	-0.720***	-0.140***
	(0.108)	(0.124)	(0.124)	(0.112)	(0.025)	(0.028)	(0.031)	(0.025)	(0.041)
language	0.752***	0.871***	0.869***	0.773***	0.489***	0.406***	0.434***	0.511***	0.269***
	(0.059)	(0.064)	(0.064)	(0.061)	(0.014)	(0.016)	(0.019)	(0.014)	(0.022)
AGgdpexporterX gdpimporter	0.611***	0.701***	0.700***	0.558***	0.534***	0.580***	0.184***	0.506***	
	(0.065)	(0.077)	(0.077)	(0.068)	(0.016)	(0.018)	(0.024)	(0.016)	
tariff							-0.060***		
							(0.006)		
Time taken		-0.902***	-0.692***			-0.326***			-0.504***
		(0.054)	(0.085)			(0.012)			(0.017)
Trend*timetaken			-0.022**						
			(0.007)						

Table 2. Impact of transport costs and other variables on trade in agricultural products (*cont.*)

Exporter AG gdp									0.458***
									(0.038)
Importer gdp									0.719***
									(0.038)
No. international peaks									-0.021***
									(0.005)
rta					0.367***	0.657***		0.404***	
					(0.026)	(0.030)		(0.026)	
Constant	10.327***	-4.739**	-5.307**	13.726***	0.230	-1.634	8.595	5.655	-3.481*
	(2.047)	(1.764)	(1.771)	(1.783)	(0.962)	(1.331)	(37422.311)	(18506.215)	(1.710)
R-squared	0.646	0.661	0.661	0.618	0.346	0.343	0.200	0.336	0.260
N	9902	6636	6636	9902	308703	256995	219672	308704	111657

Notes: *p<0.05,**p<0.01,***p<0.001. All models estimated by 2SLS using log(value/wgt) as the instrumental variable for transport costs. Standard errors in parentheses.

35. Membership in an RTA has a large effect on the value of agricultural trade in the product level models (Models 5, 6 and 8) – an estimated increase of between 44% and 93%.[19] These effects are probably overstated. There could be a number of reasons for this, not least of which the endogeneity of concluding regional trade agreements. Indeed, countries enter into regional trade agreements in order to facilitate trade, but they often enter into agreements with countries with which they already have significant trading relationships (Baier and Bergstrand, 2007).

Impact of transport costs on trade by product group

36. The estimated effect of transport costs differs substantially between different groups of agricultural products. Estimates range from -0.045 for preparations of cereals to -0.660 for cereals for product groups that are significant (Appendix Table 2). A doubling of the cost of shipping cereals between a given country pair therefore implies a 37% drop in their bilateral trade in cereals, other things being equal. Most commodity groups' estimates fall between -0.2 and -0.4, which is consistent with the range of estimates found in most of the product level model specifications outlined above.

37. Transport costs affect trade particularly strongly in those products that are transported in bulk: cereals (coefficient -0.660) and, to a lesser extent, sugar (coefficient -0.453). Other product groups that are particularly impacted by changes in transport costs are fats and oils (coefficient -0.476), prepared meat and fish (coefficient: -0.444) and cocoa (coefficient: -0.429). Some of these products groups are exported particularly by developing countries. A doubling of transport costs between a given pair of countries implies a 27% drop in their trade in sugar, a 26% drop their trade in cocoa, and a 37% drop in their trade in cereals other things being equal (Appendix Table 2).

38. The effect of RTA membership has mixed effects on the value of agricultural trade at the 2 – digit level– an estimated increase in trade of between 26% (for miscellaneous edible preparations) and 410% (for live trees and other plants).[20] Many of the estimated effect of RTA membership are very large, and are probably overstated. As highlighted earlier, endogeneity issues with respect to entering into RTAs are likely to be driving these results.

Some implications of this study

39. Analysis of the new dataset on maritime transport costs has underscored the importance of shipping in determining trade flows. The cost of shipping represented ten percent overall of the cost of importing goods worldwide in 2007, and maritime transport costs are even higher for some products and some countries. Lower income, net food importing countries pay particularly dearly for imports of staple foods. The shipping cost of importing grains to some of these countries is 20-30% of their 2008 import value. The cost of importing grains (in cost per weight) has also risen sharply in recent years – by 250% in the last five years in some cases to be followed by dramatic decreases in recent months.

40. As compared with tariff levels, maritime transport costs are more highly dispersed. Shipping costs are therefore more differentiated according to country of origin and destination and the nature of the product being shipped as compared with tariffs.

41. Trade between countries with high maritime transport costs suffers greatly. A doubling of maritime transport costs between a given country pair is associated with a decline of 18 to 43% in the value

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19. The estimated effect of the dummy variable is calculated as $(\exp(\beta)-1)$ when the dependent variable is in logs and refers to a discrete change in the dummy from 0 to 1.

20. The estimated effect of the dummy variable is calculated as $(\exp(\beta)-1)$ when the dependent variable is in logs and refers to a discrete change in the dummy from 0 to 1.

of their agricultural trade. Increases in transport costs negatively impact trade flows in almost all products, but particularly impact trade in cereals and in some products exported by developing countries such as cocoa and sugar. A doubling of transport costs between a given pair of countries leads to a 37% drop in their trade in cereals, ceteris paribus.

42. Since transport costs have been shown to have in important impact on trade flows, it is important that all actors do what is possible to enhance maritime transport efficiency. Many factors underlying transport costs are not policy-determined: distance from major markets, the price of oil and other inputs, etc. Some elements are more easily influenced – investments in port infrastructure, for example, an important determinant in trade costs, can have a significant downward effect on trade costs. (See the companion paper to this one, *Determinants of Maritime Transport Costs in Agriculture* (forthcoming) for a fuller discussion of this and other related points).

43. The importance of maritime transport costs in agricultural trade, confirmed by the analysis of the new dataset, has implications for the debate on aid for trade and for analyses of world food supply crises. The high volatility of maritime costs has been particularly detrimental to low income countries and net food importers. These countries, which are already facing higher transport costs, generally import much of their food. Since many staple foods (grains, rice) are subject to high transport costs, measured as a percentage of their imported value, their trade is particularly impacted by changes in shipping rates.

44. Another aggravating factor in the recent volatility in transport costs is the fact that the sharp increases in shipping rates have been concomitant to sharp increases in food prices. This is undoubtedly due to many macro-economic factors that have impacted both shipping and food prices -- growth in demand in emerging economies, policy changes among some major exporters, changes in exchange rates, speculation, higher oil prices, etc. This analysis also indicates that the two phenomena are interlinked – transport costs impact food and agricultural product trade and therefore prices.

45. In this context, given the finding that transport costs vary greatly between countries and over product groups, it is necessary to analyse what factors impact the level of shipping costs. A companion paper to this one examines this question and attempts to shed light on the importance of different factors such as trade volumes, trade imbalances, time spent at port, competition on the shipping route and fuel costs on the level of maritime transport costs.

Appendix Table 1.
Information Included in the Dataset

	Importers	Exporters
Full information for all products (customs data)	Argentina, Australia, Brazil, Bolivia, Chile, Colombia, Ecuador, New Zealand, Paraguay, Peru, United States, Uruguay	All destinations
of which: **Data covering manufactures and non-bulk agricultural products shipped in containers (estimates)**	China	Brazil, EU, India, Singapore, United Arab Emirates, United States
	EU	Brazil, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, Philippines, Saudi Arabia, Singapore, Thailand, United Arab Emirates, United States, Vietnam
	Hong Kong	EU, India, United States
	Japan	EU, United States
	Korea	EU, United States
	India	Brazil, China, EU, Hong Kong, Saudi Arabia, Singapore, United Arab Emirates, United States
	Indonesia	EU, United States
	Malaysia	EU, United States
	Philippines	EU, United States
	Saudi Arabia	EU, India
	Singapore	EU, India, United Arab Emirates, United States
	Thailand	EU, United States
	United Arab Emirates	EU, India, Singapore, United States
	Vietnam	EU, United States
	Importers	**Exporters**
Grains shipped in bulk	Algeria	Argentina, Australia, Canada, United States
	Bangladesh	Australia, EU
	China	Australia, Canada, United States
	Egypt	Argentina, Australia, Canada, EU, Russia, United States
	EU	Argentina, Canada, Russia, United States
	India	United States
	Indonesia	Australia, Canada
	Iran	Australia, Canada

	Importers	Exporters
Grains shipped in bulk	Japan	Australia, Canada, United States
	Jordan	Australia, Canada, EU, United States
	Libya	EU
	Mexico	Argentina, Canada, United States
	Morocco	Argentina, Canada, EU, Russia, United States
	Pakistan	Australia, Canada, Russia, United States
	Russia	Australia, Canada, United States
	Saudi Arabia	Australia, Canada, EU, Russia, United States
	South Africa	Argentina, Australia, Canada, United States
	Sudan	EU
	Tunisia	Argentina, Canada, EU, Russia, United States
	Chinese Taipei	Australia, Canada
	Venezuela	Argentina, Canada, United States
	Yemen	EU

TECHNICAL APPENDIX

Empirical Methodology

46. For a panel data set used in this study, the gravity model of agricultural trade determination takes the following form:

$$m_{ijkt} = \alpha_0 + \alpha_1 \ln\left(Y_{it}Y_{jt}\right) + \sum_{i=1}^{M} \beta_m \ln\left(t_{ijt}^{m}\right) + u_{ijkt} \qquad (1)$$

where m_{ijkt} is the log of imports of product *k* into country *i* from country *j* in period *t*, Y_{it} is total GDP for importer *i* and Y_{jt} is the value of agricultural GDP for exporter *j* in period *t*, t_{ijt}^{m} $\left(m = 1,\ldots,M\right)$ is a set of observables representing barriers to trade or costs and u_{ijkt} is a composite random error term of unobservables.

47. The trade cost function in (1) includes dummy variables to capture, any colonial relationship between the country pairs (*colony*), whether the countries share a common border or trade overland (*land*) or a common official language (*language)*. Also included is the log of shipping distance (*miles*) to capture the remaining elements of trade costs.[1] We augment the trade cost function with a variable for transport costs (*trcost*) that takes the form of log of transport cost per unit and in some specifications, shipping time (*time taken)* tariffs (*tariff*) in some models and membership of a regional trading agreement (*rta*) in others.

48. The estimating equation therefore takes the following form:

$$\begin{aligned} m_{ijkt} = \alpha_0 + \alpha_1 \ln\left(Y_{it}Y_{jt}\right) + \beta_1 tr\cos t_{ijkt} + \beta_2 miles_{ij} + \beta_3 rta \\ + \beta_4 colony_{ij} + \beta_5 land_{ij} + \beta_6 language_{ij} \;. \\ + \alpha_{ij} + \phi_k + \mu_t + \varepsilon_{ijkt} \end{aligned} \qquad (2)$$

49. Since we have multiple observations for each country pair in each year, our data are three dimensional, that is, country pair, year and product. We now have unobserved heterogeneity of three kinds; one for each cross sectional unit – country pair – one across products and finally across time. The error components are made up of α_{ij}, a time invariant unobserved heterogeneity related to each country pair, ϕ_k is a product specific unobserved effect and μ_t is an unobserved time effect. Finally, ε_{ijkt} is a classic time-varying idiosyncratic error assumed to be serially uncorrelated and uncorrelated with the independent variables in every time period (strict exogeneity). We make the further standard assumption that the

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1. The indicator used to measure distance is the actual shipping distance between major ports in each country pair as calculated in nautical miles using commonly travelled shipping routes. This may include passage through canals or on open seas, as appropriate. Data are available from e-shipping consultants maritimeChain at http://www.maritimechain.com/port/port_distance.asp.

unobserved heterogeneity is correlated with our regressors calling for a fixed-effects panel data model rather than a random effects specification.[2]

50. There are two equivalent approaches to estimating a fixed effects model with *two* dimensions (say country pairs and time). The first is to time-demean the observable variables and the second approach is to estimate the model using the least squares dummy variables technique. The latter approach includes dummy variables for each cross sectional unit – country pair fixed effects. In both approaches, the unobserved country pair heterogeneity, α_{ij} is swept away and the composite error term is no longer correlated with the independent variables. The time effect is captured by the inclusion of time dummies. Since our data are *three* dimensional, we also need to sweep out the commodity specific heterogeneity, ϕ_k by the inclusion of product fixed effects.

51. Baltagi *et al* (2003) suggest that in a gravity framework using panel data we should account for as much heterogeneity as possible and therefore suggest estimating (2) augmented further by individual importer and exporter effects, interactions of these effects with time as well as country pair specific fixed effects. This is also the preferred methodology of Baldwin and Taglioni (2006) and Egger (2008) who emphasise the need to account for multilateral resistance terms (relative prices), captured by the importer and exporter dummies, as well as the interaction terms to capture the fact that relative prices are not constant over time.[3] To ease the computational burden, we exclude country pair effects and the interaction terms. Baltagi *et al.* (2003) further argue that the country pair effects capture country pair specific heterogeneity such as distance between them, whether they share a common language, or common borders. Since we explicitly control for these factors, we omit country pair effects and rely on any residual unobserved heterogeneity to be captured by the remaining control variables as well as importer, exporter and time fixed effects. We therefore perform a within transformation to sweep out the product effects and include dummy variables for importer, exporter and time and exclude the interaction terms of importer and exporter dummies with time as well as country pair effects.

52. It is possible that the model specified suffers from simultaneity bias since there is likely to be reverse causality between transport costs and the volume of imports. Therefore, all models have been estimated by two stage least squares using the log of the value/weight as the instrumental variable for transport costs. The value/weight ratio is a suitable instrument as it is highly correlated with the endogenous variable (the unit cost of transport) but does not directly influence the volume of trade. It is therefore unlikely to be correlated with the idiosyncratic error term.

2. A random effects model was run for comparison but the Hausman test rejects the random effects model at any conventional level of significance.

3. This approach is an extension to the relative price terms discussed in Anderson and van Wincoop (2003) but who only consider a cross section of data while Baldwin and Taglioni (2006) explicitly deal with panel data.

Appendix Table 2. Impact of transport costs and other variables on trade by agricultural product group

	HS2	*trcost*	*distance*	*RTA*	*language*	*colony*	*AGgdpexporter Xgdpimporter*	*land*	*Constant*	*R-squared*	*N*
LIVE ANIMALS	01	0.240	0.797	0.486	3.201	(dropped)	-1.553	-1.929	37.265	-0.412	196
MEAT AND EDIBLE MEAT OFFAL	02	-0.071	-0.122	0.085	0.674***	(dropped)	0.797***	-1.389***	-6.822	0.122	4160
FISH AND CRUSTACEANS	03	-0.186***	-0.485***	0.257**	0.743***	1.189***	0.436***	-0.656***	-0.024	0.373	25910
DAIRY, EGGS, HONEY, & EDIBLE PRODUCTS	04	-0.355***	-0.134	1.193***	-0.119	1.235*	0.345**	-0.708***	4.558	0.145	7506
PRODUCTS OF ANIMAL ORIGIN	05	-0.119***	-0.326***	-0.130	1.031***	1.092***	0.304**	-0.837***	6.065*	0.289	5223
LIVE TREES & OTHER PLANTS	06	0.048	0.251*	1.630***	0.299*	0.611*	0.259	-0.587*	0.932	0.464	2877
EDIBLE VEGETABLES	07	-0.140***	-0.424***	0.420***	0.285***	0.764***	0.659***	-1.385***	-1.646	0.267	20505
EDIBLE FRUIT NUTS, PEEL OF CITRUS/MELONS	08	-0.228***	-0.137*	1.343***	0.336***	0.108	0.419***	-1.572***	1.680	0.279	19436
COFFEE, TEA, MATE AND SPICES	09	-0.281***	-0.473***	0.755***	0.326***	0.100	0.440***	-0.511***	3.977**	0.412	27470
CEREALS	10	-0.660***	-0.396***	0.160	0.106	0.909	0.127	-0.455*	8.553*	0.152	6223
MILLING INDUSTRY PRODUCTS	11	-0.259***	-0.623***	0.617***	0.300***	1.051***	0.654***	0.118	0.964	0.248	11503
OIL SEEDS/MISC GRAINS/MED PLANTS/STRAW	12	-0.304***	-0.575***	-0.252*	0.415***	-0.082	0.370***	-0.499***	5.428*	0.314	16197
LAC, GUMS, RESINS ETC	13	-0.397***	-0.420***	-0.133	-0.084	-0.044	0.472***	-0.499***	1.000	0.396	6808
VEGETABLE PLAITING MATERIALS	14	-0.095**	-0.421***	-0.406	0.442***	1.318***	0.061	0.119	12.813***	0.347	3647
ANIMAL OR VEGETABLE FATS, OILS AND WAX	15	-0.476***	-0.586***	0.080	0.196**	1.682***	0.271***	-0.325**	6.931***	0.202	16969
ED PREP OF MEAT, FISH, CRUSTACEANS, ETC	16	-0.444***	-0.512***	0.392**	0.863***	1.298***	0.406***	-1.157***	3.804	0.374	14218

Appendix Table 2. Impact of transport costs and other variables on trade by agricultural product group (*cont.*)

SUGARS AND SUGAR CONFECTIONARY	17	-0.453***	-0.668***	0.127	0.759***	1.090***	0.526***	-0.479***	4.639*	0.272	12246
COCOA AND COCOA PREPARATIONS	18	-0.429***	-0.611***	0.556***	0.957***	-1.013***	0.347***	-0.944***	5.325*	0.240	8871
PREPS OF CEREALS, FLOUR, STARCH OR MILK	19	-0.045*	-1.290***	0.964***	0.845***	1.109***	0.844***	-1.023***	1.556	0.359	18785
PREPS OF VEGS, FRUITS, NUTS	20	-0.305***	-0.666***	1.148***	0.335***	1.095***	0.864***	-1.495***	-3.524**	0.361	37593
MISC EDIBLE PREPARATIONS	21	-0.371***	-1.226***	0.234*	1.197***	1.560***	0.755***	-0.445***	3.133*	0.372	17865
BEVERAGES, SPIRITS & VINEGAR	22	-0.258***	-0.897***	1.179***	0.954***	0.555*	0.781***	-1.282***	-0.620	0.415	14514
RESIDUES FROM FOOD INDUSTRIES, ANIMAL FEED	23	-0.417***	-0.692***	-0.603***	0.434***	-0.109	0.617***	-0.679***	0.854	0.132	5554
TOBACCO & MANUF. TOBACCO SUBSTITUTES	24	-0.392***	-0.308**	-0.521	0.039	1.301***	0.475***	-0.153	2.639	0.337	4427

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