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TIME AS A TRADE BARRIER: IMPLICATIONS FOR LOW-INCOME COUNTRIES

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This article builds on and extends the quantitative part of OECD Trade Policy Working Paper No 35 co-authored by Enrico Pinali and Massimo Geloso-Grosso. The Working Paper includes detailed case studies as well as a discussion of specific GATS issues related to the logistics services sector. The author would like to thank Dale Andrew, Henk Kox and Delegates to the Working Party of the Trade Committee for useful comments on the Working Paper and Paul Swaim and Mark Pearson for useful comments and suggestions on this version. The usual disclaimer applies.

INTRODUCTION

It is no coincidence that cities and industrial clusters are located around good harbours or other nodes in transport networks. Easy access to food, industrial inputs and markets goes a long way in explaining the location of economic activities. One would, however, expect that with improved transport and communication technology, economic activity would become more evenly spread across the globe. This has not happened. Geographical clustering of economic activities has actually increased while the world's most peripheral countries have become increasingly economically remote.[1]

This paradox is first due to the fact that as transport, communication and other trade costs come down, more is traded and trade costs remain as important as ever for location of production.[2] A major reason why firms chose to increase their expenditure on transport is that this is more than compensated by gains from savings on input prices and inventories.[3] Thus, manufacturers increasingly outsource non-core activities to outside suppliers who often are expected to deliver their goods or services several times per day while only minutes of delay on each delivery are tolerated.

Second, remote areas become relatively more economically remote when infrastructure and logistics are improved in central areas. Better roads will encourage investment in bigger trucks that cannot economically service remote areas; better ports encourage investment in larger and faster vessels that bypass smaller ports and so on. For many developing countries this means that integration into world markets requires a long leap forward as far as availability and quality of transport and other logistics services are concerned.

Another factor disadvantaging peripheral countries is the diffusion of just-in-time (JIT) production systems. Beyond their application to advanced manufacturing JIT is also increasingly important in the retail sector, where the practice has been coined lean retailing. One example is fast fashion where new models designed on the basis of observed consumer behaviour are introduced at frequent intervals. This usually requires that suppliers are located close to the market where production costs can be relatively high.[4] However, fashionable products that are only available for a short season fetch a higher price in the market and this compensates for higher costs, it is claimed.

The purpose of this paper is to shed more light on the time dimension of trade costs and assess the extent to which time constitutes a barrier to trade. It not only focuses on how time affects the size of observed trade flows, but more importantly it analyses lead time and time variability as barriers to entry in foreign markets. The novel contribution of the paper is to explore both the determinants of market entry and the determinants of subsequent trade flows. It is argued that the decision to enter a new export market is different from the decision to expand in an existing market. Or seen from the importers' point of view the decision to look for a new supplier in a different country is different from extending a contract with an existing supplier.[5] In either case, a new supplier/customer relationship requires fixed up-front costs on both sides. If for instance firms cannot meet foreign customers' lead time and reliability requirements, they will not be short-listed for bidding on contracts unless investments in better supply chain management systems and better quality control are made, sometimes involving hefty ICT expenditures.

The study makes use of a recently published dataset on time for exports and imports to derive quantitative estimates of the impact of time on exports to three selected markets: Australia, Japan and the United Kingdom. It is found that time has a large impact on the probability that a country will export time-sensitive products, such as electronics and industrial inputs, to these countries, particularly to Japan and Australia. Furthermore, it is found that time for exports has at least as large an impact on trade volumes as has previously been found for tariffs and transport costs.

A popular methodology for analysing the impact of trade costs on trade flows is the gravity model (Anderson and van Wincoop, 2004). Hitherto zero trade flows have been largely ignored – an omission that leads to biased estimates (Helpman *et al.* 2006; Santos Silva and Tenreyro, 2006). I avoid this problem by first estimating the probability to export and next the determinants of positive export flows adjusting for the effect of zero trade flows. The determinants of the probability to export are interesting in themselves and highly relevant for the current policy debate on the impact on globalisation on developing countries. It is argued that the policy measures needed to reduce entry costs for potential exporters, many of which are external to these firms, are often different from those best suited to increase export volumes for current exporters. Entry costs in low-income countries are often related to features behind the border, including customs procedures, inadequate logistics services and infrastructure. By contrast, traditional trade policy measures, such as tariffs, constitute a variable trade cost that mainly affects existing trade flows. It thus appears that trade liberalisation needs to be complemented by domestic reforms leading to more competitive logistics services, more efficient customs services and probably investments in infrastructure in order for developing countries to fully realise the potential gains from trade liberalisation.

The study is organised as follows. The next section reviews existing research on time as a trade barrier. The following section presents an econometric analysis of exports to Australia, Japan and the United Kingdom. The relation between time for exports and trade is estimated for total merchandise exports, as well as for exports of intermediate goods, fashion clothing and electronics, three sectors for which trade flows may be particularly sensitive to time. The three chosen export destinations are developed economies to which imports must arrive either by sea or air. Accordingly, exporters face similar conditions at the receiving end, and observed impacts of time and distance can be assumed to stem from conditions in the exporting country. Finally, policy implications of the analysis are discussed.

TIME, LOGISTICS AND TRADE – HOW ARE THEY RELATED?

Time to export

There are three concepts related to time that need to be considered when discussing time as a trade barrier: lead time, time variability and just-in-time. Lead time is the amount of time between the placement of an order and the receipt of the goods ordered, while time variability is measured by the (statistical) variation in lead time. Just-in-time refers to a way of organising production where inbound as well as outbound inventories are kept to a bare minimum and inputs arrive at the factory at the point where they enter the production process. Lead time and its variability are determined on the supply side, while just-in-time is a requirement on the demand side.

Both lead time and time variability constitute trade and entry barriers and these are more important the more widespread just-in-time technologies are. Lead time depends on the nature of the product *e.g.* whether it is made to order or if it is a "from the shelf" product. It also depends on planning and supply chain management, logistics services and of course distance to customers and suppliers. Long lead time does not need to be a problem if time variability is low and demand is stable.[6] However, if there is uncertainty about future demand, long lead time is costly even when the customer knows exactly when the merchandise will arrive. If future demand has been underestimated, running out of stock has costs in terms of foregone sales and the possibility of loosing customers. If future demand has been overestimated, excess supply must be sold at a discount.

The more varieties, the larger stocks are needed and the higher the time costs. The more variable the delivery time, the larger the buffer stocks that are required. Thus, even if the average lead time is low, a high rate of variability can render a supplier uncompetitive and can be more damaging than having long, but predictable lead times. The impact of lead time and time variability also depends on the number of varieties of the product in question, since separate stocks will be required for each variety. Finally it is important to notice that competitiveness on time is not a static concept. When a critical mass of suppliers are able to deliver just-in-time and the customer finds it safe to reduce inbound inventories to a couple of days – or in some cases even a couple of hours' supply – those who are not able to deliver just-in-time will no longer be invited to bid on contracts. Therefore, it is time relative to competitors that matters for market entry. Time relative to all other countries is the measure that is used in the econometric analysis in the next section.

Transit time in international trade has come down over the past decades due to faster ships, more effective multi-modal transport and a sharp fall in the cost of air transport. The relative cost of air transport has in fact declined by 40% between 1990 and 2004 (Harrigan, 2005). This has induced a shift from sea to air transport and a reduction in the average shipping time to the United States from 40 days in 1950 to 10 days in 1998 (Hummels, 2001).[7]

The World Bank has recently conducted a survey of freight forwarders in 140 countries on freight time and costs from the factory gate until the cargo is loaded on a ship, including administrative procedures such as acquiring an export or import license, customs clearance, inspection of goods and several other indicators. Table 1 presents regional averages and the top and bottom five countries ranked by time for exports from the 2005 survey, values that range from five days

Table 1. **Time for exports and imports**

	Time for export (days)	Time for import (days)
East Asia and Pacific	25.8	28.6
Europe and Central Asia	31.6	43.0
Latin America and Caribbean	30.3	37.0
Middle East and North Africa	33.6	41.9
OECD: High income	12.6	14.0
South Asia	33.7	46.5
Sub-Saharan Africa	48.6	60.5
Denmark	5.0	5.0
Germany	6.0	6.0
Lithuania	6.0	17.0
Singapore	6.0	8.0
Sweden	6.0	6.0
Central African Republic	116.0	122.0
Iraq	105.0	135.0
Kazakhstan	93.0	87.0
Chad	87.0	111.0
Sudan	82.0	111.0

Note: Among OECD countries Mexico is included in Latin America and Caribbean, the Czech Republic, Hungary, Poland and the Slovak Republic are included in Europe and Central Asia.
Source: World Bank.

to over 100. In some developing countries these time costs alone account for a lead time beyond the requirement of customers in developed countries.

Time to import

Manufactured exports contain a considerable amount of imports, particularly in industries characterised by international production sharing. International production networks involve the location of various production stages in different countries and imply that the components embodied in a product have crossed international borders several times before it reaches the consumer. A commonly used measure of vertical specialisation is the import content of exports and it has increased steadily over the past 35 years.[8] However, the rate of increase appears to have slowed down in recent years and for Denmark and Japan the import share of exports has actually declined slightly since 1990. One possible explanation for this is that more time-intensive production technologies and ever leaner and more sophisticated supply chain management lead to agglomeration of firms in concentrated areas, and that a larger number of activities are located within a country, particularly in large countries.[9]

Electronics and clothing are characterised by elaborate international production networks where timely delivery is of utmost importance. In 2001, the import content was 32% of export value in the electronics sector in China, 55% in Ireland, 65% in Thailand and 72% in the Philippines. In the clothing sector, the import content of exports was 43% in Sri Lanka, 40% in Vietnam, 54% in Ireland, 80% in Botswana and 38% in the Philippines to mention but a few.[10] These high shares suggest that time for imports may be as important for lead time as is time for exports. In four of the bottom five counties (all except Kazakhstan) time for imports is even longer than time for exports.

Depending on at what point in the production cycle the administrative procedures related to exports can start and whether or not the necessary permits and documents are specific to each shipment or are given to an exporting or importing company for a defined time period, the time for exports and time for imports could overlap to various degrees. In a worst case scenario, the administrative procedures are repeated for each shipment and the procedures for imports start when an order is received whereas procedures for exports start only when the goods are finished. In such a scenario, lead time for exporters in the Central African Republic would be more than eight months and exports on a contractual basis to retailers or downstream manufacturers would be as good as ruled out for this reason only.

While transport time once the cargo is seaborne largely depends on the distance to the export destination, there is considerable time variation among countries with similar distance to export destination due to differences in port efficiency. Clark *et al.* (2004) for instance find that improving port efficiency from the 25th to the 75th percentile (in a ranking of countries according to port efficiency) is equivalent to reducing the distance by 60%. It is also the case that routes with lower trade volumes are serviced by smaller and often slower vessels, and hence have a longer time to market.

The role of logistics services

Logistics services are involved at all stages from acquiring raw materials to delivering the finished products to the final customer, including transport, tracking, freight forwarding, inventory handling, customs, testing and packaging. Between each link in the logistics chain there is often waiting time. A challenge for logistics services providers is to minimise this waiting time and provide a seamless logistics chain.

Just-in-time combined with small inventories requires sophisticated logistics. An example of this is Ford's factory in Toronto which receives 800 deliveries a day from 300 different parts makers who deliver to 12 different points along the assembly line, without any delivery being more than ten minutes late. A specialist firm has been contracted to organise the inbound logistics system.[11] Although supplies must be kept close to the assembly line in such cases, suppliers can still be found further a field when the logistics firm holds buffer stocks to ensure timely delivery. However, the further a field the supplier, and the more variable its lead time, the larger the share of the price the customer pays which accrues to the logistics provider.

Fast fashion is another sector where firms close to the market are at an advantage in spite of having high production costs compared to developing countries. Two examples are American Apparel and Zara. American Apparel is a vertically integrated clothing firm with production facilities in Los Angeles, employing 3 000 people. It is the largest sewn products facility in the United States, and the average wage paid to sewers is $12.50 per hour. The company also has a distribution centre in Canada and offers 2-days air-freight to Europe. It markets itself as a sweatshop-free, socially responsible company, which appears to be a successful competitive factor in addition to the speedy response to consumer tastes.[12]

In Europe, Zara, a Spanish vertically integrated fashion clothing firm has rapidly gained market share based on the fast fashion concept. It takes two weeks for a skirt to get from Zara's design team in Spain to a Zara store almost anywhere in the world. Clothing is largely manufactured in Spain and Portugal at higher production costs than rivals that produce in China, India or other low-wage countries. Nevertheless, the company claims that higher labour costs are more than compensated by higher productivity, lower distribution costs and greater flexibility.[13]

A good example of the opportunities that efficient logistics services can open for developing countries is the recent entry of African countries, notably Kenya, in the European market for cut flowers. A chill chain from the farm gate to the final customer and efficient airline services are preconditions for this trade. At first flowers were transported by passenger flights, creating linkages between the tourism and the floriculture sectors. As export volume grew, dedicated cargo flights have become commercially viable. However, south-bound flights run almost empty due to lack of demand for time-sensitive imports in Kenya. This could become a constraint on future expansion in floriculture as competition increases and margins decline. Recent developments towards direct imports by retailers are also a challenge to Kenyan exporters because this would shift more of the logistical activities, including packaging and testing to exporters.[14]

Devlin and Yee (2005) provide some interesting case studies of the role of logistics services for lead time. For example an Egyptian exporter of cotton clothing imports yarn from India and Pakistan and the time for terminal handling, customs clearance and transport from Alexandria to the company's storage facilities is 30 days. Customs clearance including waiting time takes at best two weeks. However, time variability when including the lead time of Indian and Pakistani suppliers is substantial and the company keeps storage of yarn corresponding to four months of supply in order to avoid stoppages. When the clothing is ready for exports, export documents are prepared (the time unknown). Time for packaging into a container is four hours and it takes two days from the time that the container leaves the factory gate until it is loaded on a ship in Alexandria, 220 km away. The sailing time to the export destination (New York) is 21 days, which is about average for shipments to the United States. It could, however be shorter if export volumes allowed direct shipping as there are many stops along the route that also goes via Canada.

Testing can be a critical service for exporters from developing countries where accredited test laboratories can be scarce and waiting time for testing can consequently be quite long. Worse, in small and shallow markets testing facilities that satisfy the customer may simply not exist. An example of this was reported in a study of the car industry in India. A local manufacturer of switches for passenger cars could not sell to a foreign affiliate in India because thermal shock tests that satisfied the multinational company's requirements were not available locally and the equipment to perform the tests was too expensive for in-house testing (Humphrey and Memedovic, 2003).

Finally the price a low-technology consumer good fetches in the market critically depends on to what extent it is differentiated from competitors' products. In mass consumer markets differentiation is often added late in the process, sometimes as late as at the packaging and marketing stage. Lack of expertise and speed in these areas adversely affects the price the exporter receives in the market.

The dynamics between market size, the cost of logistics services and depth of the services market constitute a virtuous cycle. As export volume increases, there is space for more service suppliers operating at lower costs, allowing for more timely delivery and further export expansion. Finally, it should be stressed that improvements in one link in the supply chain will not shorten lead time or reduce time variability unless improvements are made in complementary links as well. More efficient customs clearance services will for instance not reduce lead time if local transport and logistics services remain inefficient and uncompetitive.

Relations to previous literature

The idea that time constitutes a trade barrier in its own right is relatively new in the academic literature. The seminal contribution was Hummels (2001). He argued that time to market has two distinct effects on trade: first, it is a determinant of whether or not a manufacturer will enter a particular foreign market. An increase in shipping time of one day was found to reduce the probability that a country will export manufactures to the United States by 1.5%. Second, time affects the volume of trade once a market entry is made in a similar way as tariffs and transport costs. The tariff equivalent per day in transit was estimated at 0.8% for imports to the United States. This amounts to a tariff rate of 16% on a 20-day sea transport route, which is the average for imports to the United States. It is far and away above the actual average tariff rate.

Hummels' study is the only one to date to analyse the impact of time on both the probability to enter a market and subsequent trade flows and it is limited to imports to the United States. The analysis in the next section of this paper applies a similar methodology as Hummels on a different set of countries and thus contributes to new insights in a new field of research. Before presenting the econometric analysis, several related strands of research should also be noted.

The idea that just-in-time practices can create entry barriers has been discussed in the industrial relations literature for some time. A particularly interesting approach is the so-called O-ring theory proposed by Kremer (1993). He models production as a sequence of tasks and operations that all are essential. This means that if one task, operation or input is missing, the product cannot be finalised and it generates no revenue. The missing task or input will consequently nullify the value of all the tasks and inputs that have been performed in previous production stages. A less extreme version of the theory assigns a quality to the final product and assumes that in order for the final product to have the desired quality all inputs must have the minimum required quality. Examples of this abound. A producer of upmarket clothing with high quality fabric and elaborate designs would not choose low-quality thread, zippers or buttons. Likewise, upmarket car producers would not dream of fitting a hundred thousand dollar car with a $50 radio or a plastic dashboard. By the same token, there is no point in using high-quality fabric in a bright orange T-shirt made to last for the few months that bright orange is in fashion. Consequently an optimal strategy for an assembler will be to choose the same quality of all inputs.

Adapted to just-in-time production processes, the O-ring theory implies that if just-in-time is introduced at one stage of the production process, it is optimal to synchronise the entire supply chain in order for it to operate smoothly. The chain is only as strong as its weakest link and therefore all links should have the same strength. When just-in-time technology is introduced, delayed delivery of a component can hold up the entire production and cause costs that are much higher than the market price of the delayed component. Therefore, no discount can compensate the customer for unreliable delivery time, and firms with high variability of lead time will not be short-listed for contracts that require just-in-time delivery.

Two recent studies have introduced time for exports from the World Bank's Doing Business Survey into a gravity model of trade flows. Hausman *et al.* 2005 and Djankov *et al.* 2005 find that a 10% increase in time reduces bilateral trade volumes by between 5 and 8%. Compared to estimates of the impact of transport costs on trade flows, these are small effects.[15] A possible explanation is that these two studies suffer from a selection bias since they ignore zero trade flows, and that this bias is more serious for time costs than for transport costs since fixed costs are a more important element of the former.

To sum up this section, barriers to entry are associated with threshold levels of time to market, and a maximum tolerated variance in lead time. In fashion clothing the lead time can be as little as two weeks, while time variability can be as little as ten minutes in the car industry. In order to meet such requirements, firms in developing countries need to invest in product quality and modern management tools, particularly ICT. In addition organisational restructuring are often necessary. These investments constitute an up-front fixed cost that companies need to incur before they can enter foreign markets as regular suppliers to foreign customers. Timely delivery also requires efficient and frequent transport links, which in turn requires a critical trade volume and reasonably good infrastructure. These latter factors are beyond the control of exporting firms and require government investments in infrastructure, trade facilitation and reforms that improve the effectiveness of logistics services. In the next section I provide quantitative estimates of the impact of such reforms.

ECONOMETRIC ANALYSIS

This section presents econometric analyses of exports to Australia, Japan and the United Kingdom, focusing on the role of time. The three export destinations are chosen because they all have a broad industrial base, are open to international trade and most importantly, imports have to arrive either by sea or air. This has the advantage that differences in bilateral trade costs between exporters to these countries are likely to stem from conditions in the exporting countries, and of course distance, which can be easily controlled for. The three countries also differ in size and remoteness. Australia is relatively small and remote, the United Kingdom is relatively large and has a very central location, while Japan is the largest economy in the most dynamic region of the world and the origin of just-in-time production technologies. The three countries can thus represent a broad range of market types.

As alluded to above, time is more important in some sectors than in others. Among consumer goods fashion clothing has been shown to be particularly sensitive to time and the most time sensitive clothing items are women's and girls' clothing (HS categories 6104, 6106, 6204, 6206).[16] The electronics sector is the sector where vertical fragmentation and international supply chains are most developed suggesting that time is likely to be an important trade barrier (SITC rev 2 categories 75, 76, 77 are included). Although electronics is classified as a high-technology sector, a number of developing countries including China and the Philippines have entered international supply chains in this sector mainly in labour-intensive activities. One would also expect that parts and components that enter the manufacturing process are highly time-sensitive particularly when just-in-time technologies are applied. Intermediate industrial inputs (BEC categories 22, 42 and 53) are therefore also included in the analysis. Finally, total merchandise trade is included for comparison.

The methodology chosen for the empirical analysis is the workhorse model for analysing the impact of trade costs on trade, the gravity model. It has the advantage that it is consistent with a host of underlying trade models and that it performs very well in econometric analysis. Usually it explains 60-90% of the variation in trade flows. The model simply states that trade between two countries is proportional to the product of their GDP, which captures the impact of market size, and inversely proportional to bilateral trade costs. The trade cost that I focus on in this study is the cost of time for exports and imports. Formally the model can be written as follows:

$$T_{ij} = \alpha_0 Y_i^{\alpha_1} Y_j^{\alpha_2} D_{ij}^{\alpha_3} \quad [1]$$

Subscripts *i* and *j* signify the country pair, T trade flows between them, Y their income (GDP) and D trade costs which, in turn, are assumed to be proportional to geographical, cultural and institutional distance. The parameters $\alpha_{0,}\alpha_{1,}\alpha_2$ are expected to be positive while α_3 is expected to be negative. In most studies this equation is log-linearised and estimated using ordinary least squares (OLS).

In spite of the good performance of this methodology a number of recent studies have documented problems with it. First, it was shown that bilateral trade costs between country pairs should be seen relative to trade costs with alternative trading partners (Anderson and Wincoop, 2004). This led to the introduction of various adjustment measures including remoteness indices, fixed effects or a reference country to which relative trade costs were measured. I follow this recommendation by adjusting bilateral trade costs by dividing them with the weighted average trade costs for all country pairs.

Second, the log-linear approach misses the zero trade flows, which leads to biased estimates (Helpman *et al.* 2006; Santos Silva and Tenreyro, 2006) while only capturing the impact of trade costs on the intensive margin (*i.e.* expansion of existing trade flows). In addition Santos Silva and Tenreyro (2006) have documented that OLS estimates of the gravity model are prone to heteroskedasticity. This makes the parameter estimates inefficient, but in principle this problem alone should not lead to biased estimates. There are several ways of solving these problems. The simplest option is to truncate the observations of trade flows and estimate $ln(T_{ij} +1)$. This allows for including the zero flows, but the heteroskedasticity problem remains. In addition this methodology does not distinguish between market entry and expansion of existing trade flows. Another possibility suggested by Helpman *et al.* (2006) is to use a two-stage procedure where the probability to enter the market is estimated in the first step while the second step estimates the log-linear gravity model adjusted for the selection bias. This methodology takes into account that decisions on the extensive and intensive margins can be distinct, but does not solve the hetheroskedasticity problem. Finally, Santos Silva and Tenreyro (2006) propose to estimate the gravity model directly in its non-linear form using the Poisson pseudo maximum likelihood estimator (PPML). This incorporates both the zero flows and solves the heteroskedasticity problem. However, it does not distinguish between decisions on the extensive and intensive margin. Since this distinction is important for understanding time as a trade barrier, I estimate the probability to enter the market separately. I also report the result of the PPML estimator for comparison and as a robustness check.

I start with analysing the determinants of market entry (*i.e.* the extensive margin) focusing on the impact of time costs. For this purpose I estimate a probit function where the left-hand side variable is whether or not a country exports to the trading partner in question. A probit model builds on the assumption that the observations reflect an underlying latent variable – the ability to satisfy foreign customers' demands and requirements.

Entry barriers are related to fixed or sunk costs that firms incur up-front before they enter a contract with a foreign customer, a contract that usually specifies the time of delivery and required time regularity. In order to meet these requirements investments in better supply chain management tools are often necessary. In addition fixed costs can be related to setting up a distribution network, establishing after-sales services, learning about and complying with product standards in the foreign market, *etc*. However, it is conceivable that occasional, small export volumes can take place without traders having incurred the fixed cost of establishing a supplier relation; *e.g.* the occasional bargain, tax-free sales at airports and other forms of cross-border shopping. In order to capture the determinants of market entry on a regular contractual basis, for instance as suppliers to international production networks or lean retailers, regressions are run where the entry/non-entry cut-off rate is set to $1 million.[17] The estimated probit function reads as follows:

$$\rho_{ij} = \Phi(\alpha_0 + \alpha_1 \ln gdp_i + \alpha_2 \ln reldist_i + \alpha_3 \ln reltime + \Sigma_n \alpha_{in} x_{in}) \quad [2]$$

The variables and parameters are the following: ρ_{ij} is as a measure of the probability that firms in country *i* will export more than the cut-off value to country *j*. The parameters, α_n represent a measure of how the probability of entering the market changes with variable *n*. A positive coefficient means that the probability improves as the variable increases. The variables are GDP, relative distance (reldist) and relative time for exports (reltime) while the variables in the summation are the usual controls (common language, whether or not the exporter has had colonial ties to the importer, whether the exporter and importer are members of the same regional trade agreement, whether the exporter is an island or landlocked).[18] I estimate the probability to export to Australia, Japan and the United Kingdom respectively.

A feature of the probit technique is that the elasticity of the probability to export with respect to time is highest when the probability is around 50%.[19] On the basis of this insight it is possible to identify the countries that would benefit the most from a reduction in time for exports. I therefore present and discuss these results and their policy implications in a separate section before moving on to the estimates of determinants of trade volumes. The latter are estimated as follows:

$$\ln M_{ij} = \beta_0 + \beta_1 \ln gdp_j + \beta_2 \ln reldist_{ij} + \beta_3 \ln reltime + \beta_{\mu\eta}\overline{\eta}_{ij} + \sum \beta_k x_k + \varepsilon_{ij} \quad [3]$$

The second to last term in this equation is the inverse Mills ratio which is estimated from the probit function, but here the cut-off rate is zero. The inverse Mills ratio adjusts the gravity equation for a possible selection bias. However, the inverted Mills ratio was not always statistically significant in these regressions suggesting that selection bias is not always a problem when exports down to the dollar are included. When the inverted Mills ratio is insignificant I estimate $ln(M_{ij} + 1)$ as the second step. Finally, I also run the PPML estimator as a robustness check. Before I present the results, a brief discussion of the data follows.

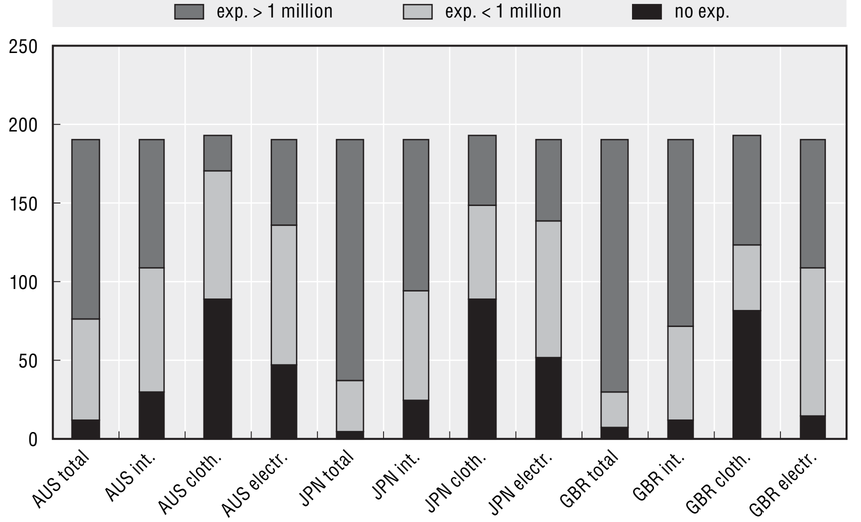
Sources of* Data *and descriptive statistics

The data assembled for this analysis consists of a panel of 192 countries covering the period 1996 to 2004. It is assumed that the countries for which the reporters (Australia, Japan and UK respectively) have no registered import in the Comtrade database, imports are zero.[20] One indicator of particular relevance to this study is the remoteness index, which is measured as the weighted average distance to all other countries, weighted by GDP in 2000. This index is about 13 000 km for Australia, 7 900 km for Japan and 6 000 km for the United Kingdom. Australia therefore probably has higher natural barriers to trade than for instance the United Kingdom. This is also reflected in the trade data as illustrated by Figure 1 which shows the number of countries not exporting or exporting less than $1 million of total merchandise exports, intermediate inputs, fashion clothing and electronics respectively for the three importers. Only 10 countries in the sample, all small economies, do not export more than $1 million to any of the three export destinations.

For all three countries, imports are more concentrated for intermediate inputs and electronics than it is for total merchandise trade and more concentrated still for fashion clothing. Japan is the largest economy among the three and it also has the largest number of suppliers of total imports. In fact only three among the 191 countries included in the database (excluding Japan) did not export at all to Japan in 2004. However, more countries export intermediate goods, electronics and fashion clothing to the United Kingdom than to Japan.

Figure 1. **Number of countries exporting to Australia, Japan and the United Kingdom in 2004**

Total merchandise exports, intermediate industrial materials, fashion clothing and electronics



Note: Total number of countries is 192. AUS, JPN and GBR represent Australia, Japan and the United Kingdom respectively; total, int., cloth. and electr. represent total merchandise trade, intermediate industrial inputs, fashion clothing and electronics, respectively.
Source: Comtrade.

Data on time for exports from the World Bank are only available for 140 countries in 2004. An analysis using panel data therefore requires that a proxy be found for time for exports. Control of corruption turns out to be useful in this respect. In the 2004 cross-section of 140 countries, the correlation coefficient between control of corruption and time for exports is –0.62 and for control of corruption and time for imports –0.64, both significant at a 1% level. Data on control of corruption are available for every second year between 1996 and 2004 from the World Bank who also provides data for GDP.[21] The geographical indicators routinely included in gravity regressions are from CEPII.[22]

Results

The likelihood of entering the market – the extensive margin

This section analyses the determinants of entering the export markets. The results are presented in Table 2 panels A and B, which report the probability of exporting more than $1 million to each of the three markets. Robust standard errors are reported in parenthesis and ** and * indicate significance at a 1 and 5% level, respectively.[23] Fashion clothing is a relatively small sector in most countries and here I have estimated the probability that exports are positive rather than a cut-off rate of $1 million.

The results presented in panel A show that control of corruption has a positive and statistically significant impact on the probability to export in all regressions except total merchandise exports to Japan and the United Kingdom. The economic impact is largest in the electronics sector. It is remarkable that control of corruption is the variable with the largest economic impact (*i.e.* the highest parameter value) of all the variables included in the regressions in the electronics sector for all three countries. The impact of control of corruption is also large on market entry in intermediate inputs. Hence, we can conclude that control of corruption, which is a proxy for lead time and its variability has a large and significant impact on sustained market entry, particularly in the electronics sector. The direct measure of time presented in panel B reveals a similar pattern.

There is one possible problem with using time for exports as an explanatory variable for the probability to export. Transport capacity and frequency of call clearly depend on trade volumes, and causality could therefore run in the opposite direction. Using control of corruption as a proxy should solve this problem and in order to check to what extent it is a problem in the cross-section estimates I replaced the direct measure of time for exports by an instrument variable, the number of signatures needed for exports from the World Bank Doing Business Survey. This is a variable that is highly correlated with time for exports (correlation coefficient 0.77), but there is no reason to believe that it is correlated with the

Table 2. **Probit estimates of the impact of time for exports on the probability to export (cut-off $1 million)**

Panel A. Panel estimates using control of corruption as a proxy measure for time for export, 1996-2004

	Australia				Japan				United Kingdom			
	Total	**Interm.**	**Clothing**	**Electr.**	**Total**	**Interm.**	**Clothing**	**Electr.**	**Total**	**Interm.**	**Clothing**	**Electr.**
Lngdp	0.80**	0.93**	0.50**	0.62**	0.50**	0.55**	0.49**	0.80**	0.86**	0.80**	0.50**	0.63**
	(0.06)	(0.06)	(0.04)	(0.06)	(0.06)	(0.05)	(0.04)	(0.10)	(0.08)	(0.06)	(0.04)	(0.05)
Lnreldist	−1.04**	−1.32**	−0.60**	−0.56**	−0.89**	−1.40**	−0.73**	−1.05**	−0.32	−0.92**	−0.29*	−0.70**
	(0.16)	(0.19)	(0.13)	(0.20)	(0.23)	(0.18)	(0.14)	(0.20)	(0.26)	(0.19)	(0.14)	(0.13)
Island	0.33	0.66*	0.14	0.45*	0.42*	−0.66**	0.41*	1.00**	0.28	0.55*	0.37*	0.54*
	(0.22)	(0.28)	(0.19)	(0.23)	(0.20)	(0.20)	(0.18)	(0.34)	(0.23)	(0.23)	(0.19)	(0.22)
Landlocked	−0.12	−0.30	0.03	0.19	−0.40**	−0.19	−0.05	0.67**	−0.49**	−0.40**	−0.17	−0.45**
	(0.15)	(0.21)	(0.13)	(0.20)	(0.16)	(0.14)	(0.13)	(0.25)	(0.19)	(0.15)	(0.14)	(0.18)
Language	0.24	0.38	−0.19	0.38					1.87**	0.85**	0.28	−0.06
	(0.19)	(0.23)	(0.15)	(0.23)					(0.35)	(0.26)	(0.20)	(0.21)
Colony			0.12			−1.87**	−1.49**	−0.42	−0.86**	−0.23	−0.07	0.55**
			(0.64)			(0.32)	(0.28)	(0.31)	(0.30)	(0.23)	(0.16)	(0.17)
RTA dummy												−0.99**
												(0.39)
Lncorr	1.45**	2.05**	0.73**	2.15**	−0.00	1.27**	1.05**	1.57**	0.43	0.47*	0.74**	1.55**
	(0.25)	(0.28)	(0.18)	(0.24)	(0.22)	(0.24)	(0.22)	(0.21)	(0.29)	(0.24)	(0.21)	(0.27)
N	821	821	826	821	815	829	829	829	767	767	767	837
Pseudo R^2	0.53	0.64	0.38	0.60	0.30	0.47	0.40	0.65	0.44	0.50	0.35	0.57

Table 2. **Probit estimates of the impact of time for exports on the probability to export (cut-off $1 million)** (*cont.*)

Panel B. Cross-sectional estimates using a direct measure for time for exports, 2004

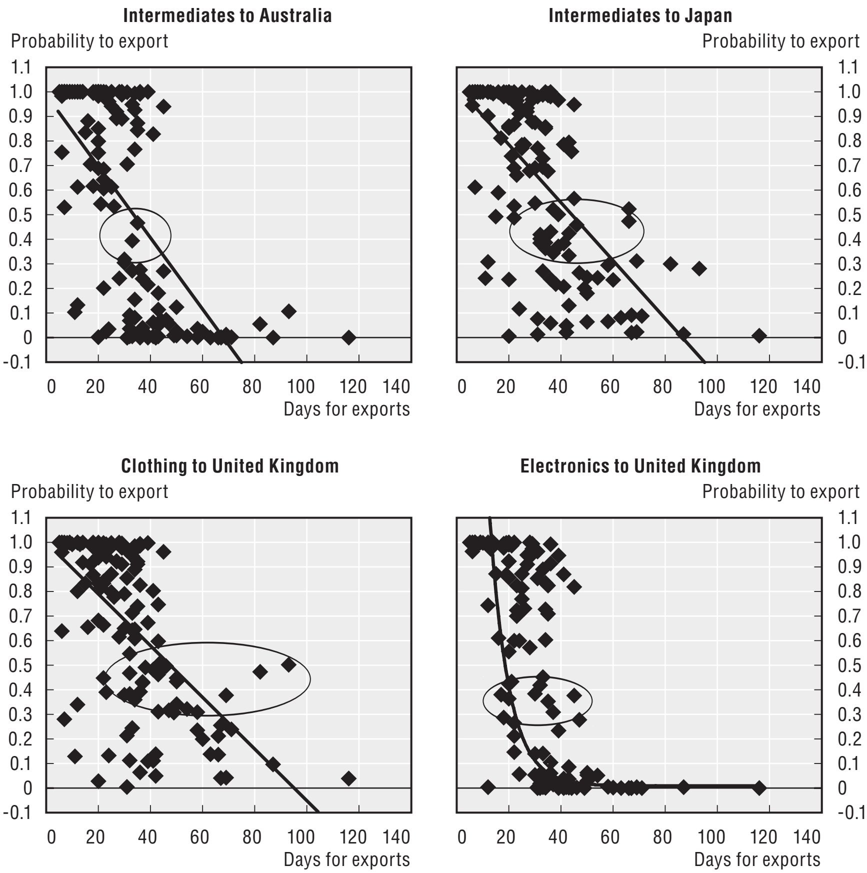
Variable	Australia				Japan				United Kingdom			
	Total	**Interm.**	**Clothing**	**Electr.**	**Total**	**Interm.**	**Clothing**	**Elelctr.**	**Total**	**Interm.**	**Clothing**	**Electr.**
Lngdp	0.68**	1.08**	0.45**	0.85**	0.71**	0.56**	0.55**	0.89**	1.78**	0.89**	0.59**	0.72**
	(0.14)	(0.19)	(0.09)	(0.12)	(0.20)	(0.13)	(0.11)	(0.13)	(0.34)	(0.18)	(0.13)	(0.12)
Lnreldist	–0.69*	–0.69	–0.03	–0.14	–1.88**	–1.37**	–0.80*	–0.67	0.27	–1.06*	0.55	–0.99**
	(0.35)	(0.43)	(0.38)	(0.43)	(0.65)	(0.49)	(0.41)	(0.44)	(0.81)	(0.55)	(0.37)	(0.41)
Island	0.25	0.94	0.35	0.57		–0.97	0.53	0.68	–0.25	–0.09	0.18	0.61
	(0.54)	(0.73)	(0.67)	(0.57)		(0.57)	(0.54)	(0.58)	(0.58)	(0.54)	(0.51)	(0.45)
Landlocked	–0.06	0.13	–0.10	0.13	–0.41	0.12	0.17	0.91	–0.69	–0.95*	–0.01	–1.42**
	(0.38)	(0.56)	(0.33)	(0.38)	(0.45)	(0.39)	(0.32)	(0.50)	(0.62)	(0.44)	(0.37)	(0.48)
Language	0.05	0.14	–0.01	0.40					5.51**	1.88**	–0.35	0.03
	(0.48)	(0.71)	(0.41)	(0.41)					(1.29)	(0.70)	(0.54)	(0.54)
Colony						–1.84**	–1.73**	0.23	–2.85**	–1.10*	–0.14	0.63
						(0.75)	(0.70)	(0.71)	(0.85)	(0.55)	(0.47)	(0.48)
RTA dummy												
Ln reltime	–0.74*	–1.51**	–0.50*	–0.93**	–0.62	–1.21**	–0.46	–0.87**	0.35	–0.24	–0.69*	–0.81*
	(0.31)	(0.42)	(0.26)	(0.36)	(0.53)	(0.33)	(0.27)	(0.32)	(0.55)	(0.31)	(0.30)	(0.42)
N	132	132	132	132	118	134	134	134	123	123	123	123
Pseudo R^2	0.47	0.69	0.34	0.64	0.44	0.49	0.39	0.66	0.71	0.56	0.41	0.66

Note: Cut-off for fashion clothing is zero. Where a dummy variable predicts success perfectly, it is dropped in the regression and the corresponding observations are not used. This explains why the number of observations varies in the reported regressions. For the United Kingdom the regional agreement dummy included is whether or not a trading partner is a member of the EU.

error term. The parameter estimates were similar and their statistical significance was even stronger than when using the direct measure of time.

The parameters in Table 2 do not provide much information about the magnitude of the effects reported except giving the direction of change. Figure 2 illustrates the relationship between time for exports and probability to export for intermediate inputs to Australia and Japan and for fashion clothing and electronics to the United Kingdom respectively. The probability of exports falls off the most steeply with time for exports in the electronics sector (this applies to exports to Australia and Japan as well). It is also noticeable that the predicted probabilities for exports tend

Figure 2. **Predicted probabilities to export**



Note: The predicted probabilities are post-estimates of equation 2 using the parameters presented in Table 2, panel B.

to be either high or low, with relatively few countries in the middle. Yet, the countries in the middle are the most interesting from a policy point of view.

One important insight from probit analysis is that it gives some guidance to which countries would benefit the most from reforms. The impact of an improvement in timeliness is likely to be largest for the countries with predicted probability to export below, but not too far below 0.5. These countries are close to fulfilling the conditions for market entry, but are not quite there yet, and reforms could have a significant impact. For those countries where the probability is close to zero, more thorough reforms are needed in order to enter export markets for time-sensitive products. For those with a probability well above 0.5, the relevant policies are more related to enhancing export volumes, diversifying exports beyond the region and entering export markets in even more time-sensitive products within each sector. The ovals included in the figures encircle the countries with the estimated probability to export between 0.3 and 0.5.

Among the countries with probabilities in this range in more than one sector and to more than one market are Albania, Belarus, Bosnia and Herzegovina, Kenya, Romania, Tanzania, Ukraine and Vietnam. Some of the countries encircled actually do export in spite of the odds. An example of this is Cambodia's exports of fashion clothing, which can be explained by industrial policies promoting this sector and proximity to other large-scale exporters who have integrated Cambodia in regional supply chains. Small island economies such as Samoa and other small and remote countries such as Tajikistan have relatively high natural barriers to trade and a low probability to export even if time for exports is relatively short. A final note of caution is, however, called for. Although these results help identify which countries would benefit the most from reform, results must be used with caution and should be combined with other indicators and considerations.

Distance, time and trade volume

In this section the results of estimating equation (3) are discussed. The results are presented in Table 3 where panel A shows panel estimates using control of corruption as a proxy measure for time for exports while panel B shows cross-section estimates using the direct measure for time for exports. Where the inverted Mills ratio turned out to be insignificant, an OLS regression estimating the determinants of $ln(M_{ij}+1)$ is applied. The two can be distinguished in the table where the number of censored observations is reported for the Heckman regressions while the adjusted R^2 is reported for the OLS regressions. The parameters in these regressions give an estimate of the percentage change in exports as a result of a 1% change in the variable in question (everything else being equal).

It is first noted that the dummy variables usually included in gravity regressions such as colonial ties, common language and whether or not a country pair is member of the same regional trade agreement do not perform well in the regressions. A

Table 3. **Estimates of the gravity model: impact of time for exports on export volume**

Panel A. Panel estimates using control of corruption as a proxy measure for time for exports, 1996-2004

	Australia				**Japan**				**United Kingdom**			
	Total	**Interm.**	**Clothing**	**Electr.**	**Total**	**Interm.**	**Clothing**	**Electr.**	**Total**	**Interm.**	**Clothing**	**Electr.**
Lngdp	1.34**	2.60**	2.59**	1.76**	1.07**	1.48**	1.22**	2.06**	1.36**	1.77**	2.77**	1.34**
	(0.05)	(0.13)	(0.13)	(0.07)	(0.05)	(0.05)	(0.08)	(0.26)	(0.07)	(0.08)	(0.15)	(0.04)
Ln Reldist	–2.31**	–3.33**	–3.48**	–1.77**	–1.58**	–2.23**	–2.00**	–3.15**	–1.03**	–1.55**	–2.33**	–0.93**
	(0.15)	(0.51)	(0.52)	(0.26)	(0.20)	(0.21)	(0.23)	(0.66)	(0.27)	(0.32)	(0.57)	(0.13)
Island	–0.11	2.29**	0.33	1.44**	0.48	–0.37	0.85*	0.44	0.51	0.59	2.74**	0.87**
	(0.25)	(0.78)	(0.81)	(0.44)	(0.29)	(0.31)	(0.36)	(0.22)	(0.43)	(0.50)	(0.90)	(0.25)
Land-Locked	–0.31	–1.26*	–0.83	–0.04	–0.59**	–0.18	0.16	–0.07	–0.41	–0.84*	–1.45*	–0.68**
	(0.19)	(0.13)	(0.61)	(0.37)	(0.23)	(0.24)	(0.31)	(0.73)	(0.34)	(0.40)	(0.71)	(0.20)
Language	0.50**	0.81	–0.72	0.40					1.45**	1.80**	–0.80	0.63*
	0.19	(0.60)	(0.62)	(0.35)					(0.46)	(0.53)	(0.95)	(0.26)
Colony		7.07*	–2.14		–0.30	–2.82**	–1.49	–1.47	–0.23	–0.79	1.39	0.24
		(3.04)	(3.15)		(0.74)	(0.80)	(0.86)	(2.54)	(0.41)	(0.48)	(0.85)	(0.23)
RTA dummy		–5.44*	0.02		1.11	–0.18	–3.40**		–0.90	–1.75**	–2.42	
		(2.86)	(2.96)		(2.45)	(2.62)	(0.31)		(0.65)	(0.77)	(1.36)	
Ln corruption	2.67**	3.87**	3.66**	4.43**	0.31	1.76**	0.20	4.79**	0.84*	0.70	3.14**	2.10**
	(0.23)	(0.73)	(0.76)	(0.42)	(0.27)	(0.29)	(0.36)	(1.00)	(0.44)	(0.52)	(0.92)	(0.25)
N	832	832	832	830	828	828	828	828	835	835	835	837
o.w. censored	70			302			357	235				66
Adjusted R^2		0.52	0.50		0.54	0.70			0.46	0.51	0.48	

Table 3. **Estimates of the gravity model: impact of time for exports on export volume** (*cont.*)

Panel B. Cross-sectional estimates using a direct measure of time fore exports, 2004

Variable	Australia				Japan				United Kingdom			
	Total	Interm.	Clothing	Electr.	Total	Interm.	Clothing	Electr.	Total	Interm.	Clothing	Electr.
Lngdp	1.48**	2.05**	2.46**	1.72**	1.18**	1.47**	1.27**	1.64**	1.46**	1.28**	2.77**	2.14**
	(0.17)	(0.26)	(0.33)	(0.23)	(0.08)	(0.12)	(0.12)	(0.13)	(0.17)	(0.08)	(0.37)	(0.19)
Lnreldist	–1.48*	–1.57	–1.69	–1.10	–1.58**	–2.12**	–2.25**	–1.82**	–0.50	–0.82**	0.19	–1.49*
	(0.76)	(1.15)	(1.30)	(0.73)	(0.34)	(0.50)	(0.50)	(0.55)	(0.60)	(0.24)	(1.33)	(0.68)
Island	0.84	1.16	1.21	0.93	1.15*	–1.29	0.82	0.57	–1.73	0.07	1.22	–1.57
	(1.28)	(1.94)	(2.50)	(1.35)	(0.57)	(0.86)	(0.86)	(0.93)	(1.12)	(0.55)	(2.46)	(1.26)
Landlocked	–0.21	–0.04	–1.52	–0.14	–0.69	–0.02	–0.05	0.34	0.26	–0.53	–1.12	0.35
	(0.82)	(1.24)	(1.60)	(1.05)	(0.38)	(0.57)	(0.57)	(0.61)	(0.82)	(0.39)	(1.81)	(0.92)
Language	0.95	1.77	–0.77	0.21					2.69*	0.03	–2.86	0.47
	(0.87)	1.30	(1.68)	(0.95)					(1.20)	(0.58)	(2.64)	(1.35)
Colony	4.97	7.75	5.46		–0.67	–2.26	–2.31	0.95	–1.46	0.42	0.79	–0.02
	(3.87)	(5.83)	(7.51)		(1.10)	(1.65)	(1.40)	(1.79)	(1.03)	(0.50)	(2.30)	(1.17)
RTA dummy	–0.52	–1.41	0.31		0.94	–0.57	–2.14	3.49	–0.83		–0.29	–1.96
	(2.83)	(4.27)	(5.50)		(1.71)	(2.57)	(2.56)	(2.78)	(1.41)		(3.11)	(1.58)
Ln reltime	–1.55**	–2.48**	–1.76	–2.14**	–0.18	–1.37**	–0.33	–1.28**	–0.56	–0.77**	–2.72*	–0.78
	(0.59)	(0.90)	(1.15)	(0.86)	(0.27)	(0.41)	(0.41)	(0.44)	(0.59)	(0.28)	(1.31)	(0.67)
N	135	135	135	135	135	135	135	135	136	136	136	136
Ow sensored				25						6		
Adjusted R^2	0.53	0.50	0.44		0.76	0.72	0.61	0.72	0.53		0.48	0.66

Note: Standard errors are reported in parentheses.

possible reason is that although they are not as highly correlated as one may expect, they may still capture similar effects. This is probably less of a problem in gravity regressions where a large number of countries are included both as exporters and importers. Nevertheless the lack of robustness of these variables does not appear to affect the variable that we are interested in here, time for exports. It is also noted that where statistically significant the island dummy has a positive impact on trade flows. This contrasts with most other studies. It is, however, consistent with Nordås and Piermartini (2004) who find that a dummy for whether or not both trading partners are islands is significantly and positively related to trade flows. They suggest that two island economies are likely to have similar transport and logistics structures, which facilitates trade between them.

Turning to the variable of interest, control of corruption/time for exports, the impact on trade flows is found to be large and indeed larger than in most studies where zero trade flows are omitted. In panel A, where time is represented by control of corruption, a 10% improvement in this variable will increase the value of trade by between 8 and 40%, depending on the sector and the country of destination. In panel B where time is measured directly on a cross-section sample, a reduction of time for exports by 10% is found to increase trade by between 8 and 27%. The reason why the impact of control of corruption is higher could be that this variable captures the impact of time variability, since corruption is likely to be a source of uncertainty.

Finally, I compare the results of the probit estimates of market entry and the gravity estimates of the determinants of trade flows. In most cases time matters both for market entry and trade flows, although it is not significant for market entry into the broadest sectors in Japan and the United Kingdom to which most countries export. One notable exception is electronics to the United Kingdom. Here the direct measure of time has a large impact on market entry, but not on subsequent trade flows.

As mentioned above a recent critique of the empirical trade literature using the gravity model is that it does not correct for hetereoskedasticity which gives inefficient (but unbiased) estimates. These authors suggest using the Poisson pseudo maximum likelihood estimator to avoid these problems. As a robustness check, I therefore followed this advice and the results are presented in Table 4.

As in the Santos Silva and Tenreyro (2006) study, the parameters on GDP and distance are generally smaller than in the OLS regressions and this turn out also to apply to the measure of time for exports and the proxy control of corruption. For Japan only GDP is significant in the regressions for total merchandise imports, while control of corruption does not have a significant impact on trade flows except in the clothing sector where it is negative. Control of corruption is also negatively related to trade flows in the clothing sector in the two other countries. With

Table 4. **PPML estimates of the gravity model: impact of time for exports on export volume**

Panel A. Panel estimates using control of corruption as a proxy measure for time for exports, 1996-2004

	Australia				**Japan**				**United Kingdom**			
	Total	**Interm.**	**Clothing**	**Electr.**	**Total**	**Interm.**	**Clothing**	**Electr.**	**Total**	**Interm.**	**Clothing**	**Electr.**
Lngdp	1.05**	1.00**	1.57**	1.06**	0.74**	0.86**	1.27**	1.09**	0.68**	0.74**	0.53**	0.69**
	(0.05)	(0.04)	(0.34)	(0.11)	(0.07)	(0.03)	(0.06)	(0.09)	(0.02)	(0.02)	(0.07)	(0.04)
Ln reldist	–1.78**	–1.59**	–1.94**	–2.40**	–0.38	–0.86**	–2.34**	–1.68**	–0.48**	–0.32**	–0.58**	–0.25*
	(0.11)	(0.10)	(0.36)	(0.19)	(0.46)	(0.07)	(0.21)	(0.14)	(0.06)	(0.06)	(0.19)	(0.13)
Island	–1.27**	–1.13**	–2.06**	–1.51**	0.17	0.13	–0.81**	1.47**	0.09	–0.03	–0.20	0.49*
	(0.18)	(0.19)	(0.66)	(0.42)	(0.23)	(0.14)	(0.23)	(0.22)	(0.12)	(0.13)	(0.41)	(0.25)
Land-locked	0.04	–0.15	–0.31	–0.30	0.20	–0.04	0.28	–0.56*	–0.50**	–0.48**	–2.05**	–0.53*
	(0.14)	(0.13)	(0.89)	(0.23)	(0.56)	(0.18)	(0.33)	(0.29)	(0.12)	(0.09)	(0.28)	(0.24)
Language	–0.30**	–0.03	–0.41	–0.31					0.04	–0.38	–0.07	–0.33
	0.11	(0.09)	(0.55)	(0.24)					(0.16)	(0.27)	(0.34)	(0.41)
Colony	2.16**	2.45**	–5.25**	–6.07**	–0.01	–0.61**	–2.95**	–1.30**	0.21	0.43*	0.47	0.66
	(0.28)	(0.40)	(2.02)	(0.43)	(0.71)	(0.14)	(0.35)	(0.22)	(0.15)	(0.22)	(0.27)	(0.36)
RTA dummy	0.04	0.03	3.84	–1.74**	1.20	0.49**	–3.40**	1.47**	0.21	0.43**	–0.52	0.35
	(0.29)	(0.22)	(2.11)	(0.73)	(0.80)	(0.15)	(0.31)	(0.36)	(0.13)	(0.10)	(0.43)	(0.21)
Ln corruption	1.09**	1.40**	–3.13**	1.60**	–1.27	0.24	–0.96**	0.55	0.90**	1.29**	–0.70	1.17**
	(0.20)	(0.17)	(1.15)	(0.35)	(0.99)	(0.20)	(0.33)	(0.34)	(0.19)	(0.16)	(0.39)	(0.36)
N	832	832	832	830	828	828	828	828	835	835	835	837
Pseudo R^2	0.92	0.93	0.68	0.84	0.44	0.85	0.93	0.83	0.92	0.94	0.40	0.78

Table 4. **PPML estimates of the gravity model: impact of time for exports on export volume** (*cont.*)

Panel B. Cross-sectional estimates using a direct measure of time fore exports, 2004

Variable	Australia				Japan				United Kingdom			
	Total	**Interm.**	**Clothing**	**Electr.**	**Total**	**Interm.**	**Clothing**	**Electr.**	**Total**	**Interm.**	**Clothing**	**Electr.**
Lngdp	1.04**	0.98**	2.49**	1.08**	0.93**	0.88**	1.68**	1.08**	0.68**	0.76**	0.58**	0.68**
	(0.09)	(0.07)	(0.94)	(0.21)	(0.07)	(0.06)	(0.21)	(0.19)	(0.05)	(0.05)	(0.13)	(0.10)
Lnreldist	–1.65**	–1.52**	–3.85**	–2.36**	–1.23**	–0.95**	–2.56**	–1.93**	–0.51**	–0.40**	–0.55	–0.38
	(0.27)	(0.22)	(1.12)	(0.50)	(0.10)	(0.10)	(0.26)	(0.16)	(0.13)	(0.11)	(0.36)	(0.32)
Island	–1.15**	–1.05**	–4.02**	1.72*	0.58**	0.13	0.09	1.59**	–0.13	–0.01	–0.54	0.24
	(0.31)	(0.32)	(1.68)	(0.75)	(0.23)	(0.31)	(0.52)	(0.43)	(0.34)	(0.29)	(1.13)	(0.76)
Landlocked	0.20	0.07	1.24	–0.02	–0.23	0.20	0.87	–0.23	–0.49*	–0.29	–2.43**	–0.17
	(0.34)	(0.28)	(1.91)	(0.53)	(0.44)	(0.46)	(0.55)	(0.62)	(0.22)	(0.20)	(0.70)	(0.55)
Language	–0.46**	–0.11	–1.73	–0.76*					–0.21	–0.83	–0.77	–0.46
	(0.17)	(0.12)	(1.14)	(0.39)					(0.38)	(0.57)	(0.82)	(0.86)
Colony	2.38**	2.83**	–0.67	–5.66**	–1.19**	–0.68**	–2.99**	–1.44	0.24	0.88	0.30	0.46
	(0.54)	(0.41)	(4.32)	(1.15)	(0.23)	(0.23)	(0.64)	(0.24)	(0.34)	(0.52)	(0.61)	(0.78)
RTA dummy	0.28	0.12	3.74	–0.87	0.74*	0.58*	–0.58	1.75**	0.11	0.51*	–1.18	–0.01
	(0.49)	(0.43)	(3.07)	(1.05)	(0.35)	(0.29)	(1.32)	(0.66)	(0.28)	(0.25)	(0.85)	(0.47)
Ln reltime	–0.45**	–0.59**	1.94	–0.79*	0.18	–0.03	1.88*	–0.04	–0.43**	–0.46**	0.41	–0.65**
	(0.18)	(0.18)	(1.12)	(0.36)	(0.26)	(0.17)	(0.77)	(0.36)	(0.12)	(0.11)	(0.28)	(0.23)
N	135	135	135	135	135	135	135	135	136	136	136	136
Pseudo R^2	0.91	0.93	0.75	0.83	0.89	0.86	0.96	0.88	0.92	0.93	0.39	0.75

Note: Robust standard errors are reported in parentheses.

the exception of Japan, the impact of time and control of corruption is robust to applying the PPML estimator.

To summarise this section, the econometric estimates indicate that time for exports is an important determinant of whether or not an exporter will enter a particular export market and time is also important for trade volumes, particularly in the electronics sector. Finally, the analysis can help identify countries that would benefit the most from reforms aiming at reducing time for exports.

POLICY IMPLICATIONS AND CONCLUSIONS

This paper has shown that lengthy time for exports and imports can be a substantial obstacle to entering export markets for entrepreneurs in developing countries. At the same time, products for which developing countries have comparative advantage are becoming increasingly time sensitive due to consumer demand for new and differentiated products, lean retailing and just-in-time production technologies. Importantly, it is lead time and time variability relative to competitors rather than absolute time for exports that matter for market entry as well as export volumes. Therefore, developing countries with long and variable lead times need to shorten their lead times and reduce time variability faster than their competitors, if further marginalisation in time-sensitive products is to be avoided.

What sort of policy measures could contribute to shortening relative lead time and improve the export performance of low-income countries? It is first noted that the measure of time for exports and imports used in the analysis covers the time from the factory gate until the merchandise is loaded on a ship destined for the foreign market. Therefore, the most relevant policy measures are behind the border and hence in the realm of domestic reforms. Furthermore, the dynamics between trade and lead time and time variability may constitute either a virtuous or vicious circle. In the latter case, poor trade performance yields low demand for effective transport and logistics services, resulting in shallow and underdeveloped logistics services and uncompetitive firms. Economies of scale in the transport and logistics sector will reinforce this low-export, poor-logistical services trap.

Lead time and time variability depend on the smooth operation of a number of services within a broadly defined logistic services sector. In addition a well-functioning customs service and other public services related to trade are needed. These activities form a logistics chain where the speed of material flow is determined by the slowest activity. Identifying the bottleneck in the supply chain and focussing the reforms on opening these is likely to yield an early harvest and could generate support for further reforms.

Where customs and related procedures constitute the weakest link in the logistics chain, trade facilitation can have a large impact on trade flows. Earlier OECD work has documented benefits and costs of trade facilitation in developing countries. This work has emphasised that more efficient and modern customs services tend to stimulate trade as well as enhancing customs revenue. Therefore, the expenses related to trade facilitation, including investment in information technology, are quickly paid back when reforms are successfully implemented. Work has emphasised the costs of not undertaking trade facilitation in a situation when trade becomes more complex and demands on customs' timely and efficient response increase.[24] The current study strengthens this argument by showing that doing nothing, while others reform, would leave firms in the non-reforming country at an increasing competitive disadvantage. In countries where time costs related customs procedures constitute a bottleneck and where in addition the probability to export is close to 0.5, trade facilitation can remove barriers to entry and induce a leap forward in terms of exports of time-sensitive goods. Furthermore, trade facilitation can in that case trigger a demand-driven expansion of logistics services in the private sector, initiating a virtuous circle.

If logistics services represent the weakest link in the chain, trade facilitation will not break the vicious circle.[25] Instead, reforms in the transport and logistics sector are a necessary first step. In low-income countries, this often involves privatisation of the transport sector combined with regulation in order to ensure that a public monopoly is not replaced by a private monopoly. Opening up to trade and foreign investment in transport and logistics services could also in many cases contribute to better services. In this study I have shown that such reforms can have large repercussions on other sectors in countries where logistics is a bottleneck and the probability to enter new markets is close to the critical value. Therefore, when considering reforms in the transport and logistics services sector, the benefits to other sectors should be factored in.

In cases when the entire logistics chain is weak, as is often the case in low-income countries, a reform package including trade facilitation and measures that stimulate the development of a diversified logistics services market is needed. These measures should aim at making the best use of existing infrastructure and institutional capacity, but this is not always enough. In many cases costly investments in infrastructure are also needed. Many of the initiatives that have been discussed under the aid for trade agenda relate to improving export capacity through better infrastructure and technology transfer and could support a reform and investment package. However, when resources are limited and the logistics chain very weak, scarce resources could be invested in special economic zones as a first step towards market entry.

The special economic zones in South East Asia and China have for instance contributed to creating a critical mass of skills and services inputs for the electronics sector (Kimura and Ando, 2005). Lessons can also be drawn from the role that trading houses in Hong Kong have played for the emergence of China as one of the world's largest traders. During the period 1988-1998 as much as 53% of China's exports were re-exported through Hong Kong where the Hong Kong trading houses added value through sorting, packaging, testing and marketing. The Hong Kong trading houses also played an important role in matching suppliers and customers. The mark-ups on Hong Kong re-exports averaged 24% indicating that the value of these services accounted for almost a quarter of the fob price (Feenstra *et al.* 2002). However, examples of unsuccessful special economic zones abound. When zones are special mainly due to tax holidays and few regulatory restrictions they often end up becoming export processing enclaves at best. What are advocated here are well located special economic zones which are special in the sense that they have good infrastructure and related services.

To summarise the study, it has shown that time is an important competitive factor and hence also a trade barrier in its own right. It not only affects the volume of trade, but also the ability of enterprises to enter export markets. Furthermore, it has been shown that it is lead time and time variability relative to other exporters that matter for competitiveness. In order to avoid further marginalisation, reforms are urgently needed since the status quo on lead time and time variability is likely to cause many low-income countries to fall further and further behind. Improving logistics could also help exporters to move up the quality ladder. Many developing countries have time for exports and imports that exceeds the level that enables local entrepreneurs to enter international production networks or to become regular suppliers to lean retailers, a situation that discourages investment in raising product quality.

Notes

1. Redding and Schott (2003) provide empirical evidence that peripheral countries have become increasingly economical remote during the period 1970-95 while Harrigan and Venables (2004) provide additional explanation and anecdotal evidence of this phenomenon.
2. World trade increased from 23 to 47% of world GDP from 1960 to 2004.
3. Duranton and Storper (2005) document that while transport costs have gone down over the past century, total trade costs have gone up due to more transport-intensive ways of organising production.
4. See Evans and Harrigan (2005) for a recent study on US trade in textiles and clothing.
5. See Hummels and Klenow (2005) for a discussion and empirical evidence.
6. If demand was known months in advance, orders on the quantity demanded could be placed months in advance as well, and lead time would not matter much.
7. The shipping time is the weighted average of ocean shipping and air freight.
8. Hummels *et al.* (2001) found that vertical specialisation measured this way accounted for 21% of world trade in 1990, up from 17% in 1970. Chen *et al.* (2005) found that this share had increased further in a number of OECD countries between 1990 and 1998.
9. See for instance Harrigan and Venables (2004) for a theory predicting such an outcome.
10. These ratios are calculated from the GTAP database for 2001, which is the only available database that distinguishes between imported and locally sourced intermediate inputs for developing as well as developed countries. See Nordås (2003) for a discussion.
11. *The Economist* December 7th 2002, Special Report Logistics.
12. See *www.americanapparel.net/mission/workers.html*, accessed 01.03.2006.
13. See *www.inditex.com/en* accessed 01.03.2006.
14. See Nordås, Pinali and Geloso-Grosso (2006) for a discussion.
15. Limao and Venables (2001) for instance find that a 10% increase in transport costs reduces trade volume by 20%.
16. Evans and Harrigan (2005) could not reveal which categories are replenishment goods due to confidentiality. However, a (somewhat dated) study by Courault and Parat (2000) found that women's and girls' ready to wear clothing had the fastest turnover in France in 1995.
17. This cut-off rate is somewhat arbitrary. Robustness checks were run for higher and lower values. It is found that a cut-off value around $1 million gives the best fit, but even when the cut-off rate is zero the results are qualitatively the same except in those cases

where all or almost all countries export to the country in question, where the variation in the data is too small to get significant results.

18. An exporter takes a decision on which countries to export to based on, among other things, the distance to the market in question *relative to all alternative markets*. The absolute distance between the country pairs is therefore adjusted by the exporters' weighted average distance to all other countries (denoted *relrem* in the equations). The distance is weighted by GDP in 2000. Likewise it is time relative to competitors that matters and the time variable is therefore normalised by dividing the absolute time for exports by the mean for all countries (denoted *reltime*). Finally gravity regressions usually include a dummy that states whether or not the trading partners have a common land border. Since the three importers in this regression do not have land borders (except for the border between Northern Ireland and Ireland), this dummy is not relevant here.
19. The probit equation can be simplified to: $\rho_{ij} = \Phi(x\alpha)$ The impact of a change in for instance time for exports on the probability to export is given by $\Phi'(x\alpha)\alpha_3$ where $\Phi'(x\alpha)$ is the standard normal probability density function evaluated at the point $x_i\alpha$. The important thing to note is that the impact of a change in time varies with the value of *x*, which in turn represents the underlying function in the bracket in the formula. It should also be noted that the impact is largest when the estimated probability is around 0.5.
20. This may not be strictly accurate since there is a category for "unspecified". Nevertheless, the trade included in "unspecified" represents a tiny share of the total and such trade would probably not represent flows of trade based on regular supplier relationships.
21. *www.worldbank.org/wbi/governance/govdata/*,*www.doingbusiness.org/Default.aspx* and World Development Indicators (CD-rom). GDP for Chinese Taipei is not included in the World Development Indicators and is taken from the Republic of China National Statistics *http://eng.stat.gov.tw/ct.asp?xItem=12700&CtNode=1561* and converted to US dollar at the nominal exchange rate.
22. *www.cepii.fr/francgraph/bdd/distances.htm*.
23. Robust standard errors are robust to possible problems of heteroskedasticity.
24. See OECD (2003a; 2003b; 2004; 2005) and Engman (2005) for further discussion.
25. Recent modelling exercises analysing the gains from trade facilitation do not capture such complementarities and in some cases they underestimate the gains from trade facilitation and in other cases they overestimate the gains, depending on which are the weakest links in the supply chain. See Engman (2005) for a discussion of these studies.

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