Essays in Export Transaction Costs

A dissertation submitted for the award of Doctor of Philosophy.

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PART A: General Declaration

Monash University

Declaration for thesis based or partially based on conjointly published or unpublished work

General Declaration

In accordance with Monash University Doctorate Regulation 17.2 Doctor of Philosophy and Research Master's regulations the following declarations are made:

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes 0 original papers published in peer reviewed journals and 3 unpublished publications. The core theme of the thesis is costs to export. The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the candidate, working within the Department of Economics under the supervision of Associate Professor Christis Tombazos.

In the case of 1 and 2 my contribution to the work involved the following:

Thesis chapter	Publication title	Publication status*	Nature and extent of candidate's contribution
1	Time and Money as Trade Barriers	Unpublished	Project Design, Literature Review, Data Collection, Data Analysis, Statistical Estimations and Write Up
2	Government Choice to Fund Export Delays Reduction	Unpublished	Project Design, Development of Theoretical Arguments and Write Up

I have renumbered sections of submitted or published papers in order to generate a consistent presentation within the thesis.

Signed: [redacted]

Date: **27/02/2015**

Declaration of Authorship

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other institution, and that to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

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Julio Cesar Mancuso Tradenta

27/02/2015

Abstract

All three chapters of my dissertation belong to the general topic of transaction costs to export. In chapter 1 we explore empirically how export delays and export monetary costs relate over time. We find evidence that suggest that countries increase pecuniary exports costs to fund innovations that decrease export delay. This implies that international organisations' singular preoccupation with export delays (at the exclusion of export costs) has the potential to retard rather than facilitate the cause of globalisation. The study also shows how domestic delays and monetary costs to export affect the volume of trade, with special focus on developing countries. Our main findings suggest that export delays are not as significant for developing countries as previously thought, while pecuniary costs - largely neglected in the literature, have a significant negative effect on how much countries trade.

Anecdotal evidence in the form of countries' self-declarations and the statistical evidence provided in Chapter 1 suggest that the monetary costs generated by governmental initiatives to reduce export delays are largely transferred to exporters. However, it is unclear why governments choose this course of action, given that increasing export pecuniary costs hinders trade. To shed relevant light, in the second chapter we provide one theoretical explanation. In this model the government objective is to maximise social welfare. We show that, by passing the costs of reductions in delays to exporting firms, governments generate market incentives that optimise economic efficiency.

The third chapter complements chapters 1 and 2 by examining the impact of export time sensitivity across industries on the patterns of trade. My findings show evidence in support of the hypothesis that, in the last decades, the supply of exports in more time sensitive industries tended to agglomerate near the demand centre. The study also shows evidence of an increase in the share of time sensitive industries in total trade. These results may be explained

by the recent introduction of new technologies, which have not only increased the demand for timeliness in trade but have also facilitated the international commercialisation of time sensitive products. The geographical agglomeration effect of time sensitivity coupled with the relative growth of trade in time sensitive industries may explain, at least in part, the fact that the average negative effect of distance on trade, in spite of recent improvements in transportation and communication technologies, has not declined, and may have even strengthened over time. Finally, my findings show that, independently of their geographical location, high-income countries not only tend to specialise in the production of time sensitive industries but also that this pattern of specialisation is consolidating over time.

Declaration for Thesis Chapter 1

Declaration by candidate

In the case of Chapter 1, the nature and extent of my contribution to the work was the following:

Nature of contribution	Extent of contribution (%)
Project Design, Literature Review, Data Collection, Data Analysis, Statistical Estimations and Write Up	70

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	Nature of contribution	Extent of contribution (%) for student co-authors only
Christis Tombazos	Project Design, Literature Review, Data Analysis, Statistical Estimations and Write Up	

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** **27/02/2015**

Main Supervisor's Signature	[redacted]	**Date** **27/02/2015**

*Note: Where the responsible author is not the candidate's main supervisor, the main supervisor should consult with the responsible author to agree on the respective contributions of the authors.

Chapter 1: Time and Money as Trade Barriers

1.1. **Introduction**

Before a shipment of goods is exported to an international destination it undergoes a number of domestic channels. Aside from inland transportation, the typical shipment is subjected to a wide range of administrative hurdles: documentation requirements, custom clearance procedures, tax evaluation, cargo inspection, and so on. Exporters are liable for two types of costs that result from such processes. The first relates to the time that is required to complete them. The length of this period, or *export delays* as it is often dubbed in the literature, is important because it has the capacity to impose significant depreciation and inventory-holding losses on shippers (Aizenman 2004; Hummels and Schaur 2013).[1] The second corresponds to an assortment of charges that are levied on exporters as their shipment progresses through the various export channels. Such pecuniary *export costs* are distinct from any monetary implications of the delay itself (e.g., loss in value due to depreciation) and, for the most part, are made up of transportation dues and government fees. The latter include cargo documentation filing fees, shipment inspection fees, administrative charges for custom clearance, port and terminal handling charges, and so on.[2]

[1] Depreciation costs correspond to literal spoilage (as in the case of fresh produce) as well as technological obsolescence, while inventory-holding costs derive from the loss of revenue that is associated with having significant capital tied up during a lengthy shipping process. Naturally, these costs are magnified in the case of high value goods (Djankov, Freund, and Pham 2010), and in the case of goods facing significant demand uncertainty (Aizenman 2004; Evans and Harrigan 2005; Hummels and Schaur 2010).

[2] Exports are also subject to delays and pecuniary costs while in international transit and also at the destination country. However, since the focus of this

Export delays and export costs have not received equal attention by economists. A slightly longer history of data availability has favored research on the former. [3] Consequently, a limited understanding of export costs is matched by a wealth of research findings on export delays. These results suggest that delays have the potential to play an important role in the decision to trade. For example, Hummels (2007) calculates tariff-equivalent *ad valorem* rates of export delays in the case of 175 countries for 2007 and finds that tariff-equivalent rates exceed tariffs faced by exporters in most of the world's regions. In the Middle East and North Africa tariff-equivalent rates exceed tariffs by a factor of about 2, in Eastern Europe and Central Asia by a factor of 3, and in sub-Saharan Africa by a factor greater than 4. Similarly, Djankov, Freund, and Pham (2010) find that on average, a one-day reduction in delays would increase exports by a staggering one percent. Independently of differences in absolute value of total exports across countries this result is, from any country's perspective very significant. To put this finding in context let us first consider the case of Thailand, which is a country with a relatively large absolute value of total exports ($191,406,220,234 in 2010). A 1% of the value of exports in this country was, for example, equivalent to 15.8% of the total government expenditure on education (3.8% of GDP). On the other hand, the value of total exports of a country like Cambodia is comparatively small ($5,576,882,484 in 2010). However, a 1% of total exports in Cambodia

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study is on export facilitation policies and their impact on trade, only domestic export delays and pecuniary export costs are considered.

[3] For example, the study on export delays by Djankov, Freund, and Pham (2010) relies on 2005 the World Bank "Trading Across Borders" survey data when this survey was not collecting export cost data.

corresponded to 19.1% of total government expenditure on education (2.6% of GDP).[4]

The emerging prominence of export delays as a major obstacle to trade coupled with the decreasing relevance of global tariffs are likely to have contributed to the shaping of recent policies. In particular, they may help explain why the task of reducing export delays is a leading priority of trade facilitation initiatives that have been recently undertaken by a variety of regional and international organizations including APEC (2007), ASEAN (2005), WCO (2005), and UN-ESCAP (2004). The most notable such example is the August 2004 agreement of the 147 members of the World Trade Organization (WTO) to begin negotiations on a resolution that would radically expedite the domestic movement, inspection, and custom clearance procedures to which traded goods are typically subjected (WTO 2004, Annex D).[5] In terms of achieving their primary objective to reduce delays, these initiatives appear to be remarkably successful. Using survey data that was provided to us by the World Bank we constructed Table 1.1 that summarizes all trade facilitation reforms undertaken by a total of 122 countries during 2006-2010. According to this Table, almost 40 percent of the 93 developing countries in the sample took steps to reduce domestic export delays. By way of comparison, only about 4 percent of such countries claim to have implemented reforms to facilitate trade by decreasing pecuniary export costs.

The neglect of export costs by researchers and policy makers is troubling for two reasons. First, while such costs vary considerably from country to

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[4] Government total expenditure on education is from The World Development Indicators (2010) http://data.worldbank.org/indicator/SE.XPD.TOTL.GD.ZS

[5] The WTO negotiations are ongoing and have not yet led to an enforceable agreement. Still, there is considerable evidence that they have served as a catalyst for the early undertaking of the type of reforms that would be required by such an agreement (Finger 2008).

country, data that has been recently made available by the World Bank suggests that they are often significant – particularly in developing countries. In the most extreme cases, such as the Republic of Chad and the Central African Republic, export costs typically correspond to about 30% of the value of containerized exports. [6] Second, there is mounting evidence that governments often fund the innovations that make delay reductions possible by increasing the export fees borne by exporters. See in particular official communications that have been tabled in the context of ongoing WTO discussions to refine the 2004 resolution such as WTO (2005a, 2005b), as well as in Bjelic and Popovic Petovic (2009) and in recent publications like World Bank's Doing Business Report (2014), UNECA (2013) and ADB (2013).[7]

Under the circumstances, by overlooking export costs previous studies failed to shed light on a trade impediment that, at least *prima facie*, is large enough to play a role may be as significant as that of delays. More importantly, the possibility of a causal link between delays and costs suggests that researchers' and policy makers' investigation of the former in isolation of the latter is problematic. It has the capacity to introduce an important source of bias in relevant research and can lead to sub-optimal, perhaps self-defeating, trade facilitation initiatives.

Our empirical analysis in this chapter is a first attempt to examine the link between export costs and export delays, on the one hand, and the combined effect of both impediments on exports, on the other. Our results are striking. First, they provide strong support for the notion that export costs are endogenous with respect to delays. Second, they suggest that, when exports costs are included in the analysis, export delays have no discernible impact on developing country exports. By contrast, export costs are found to be the dominant impediment to exports. This is a reversal of the narrative proposed

[6] See World Bank's Doing Business report for 2010.

[7] For the relevant text of these references please see the Appendix.

by earlier contributions that study export delays in isolation, and has important policy implications.

The remainder of this article proceeds as follows. The next section presents our empirical methodology. Section 1.3 summarizes the data. Section 1.4 discusses the method of estimation and our findings. Concluding remarks are reserved for the last section.

1.2. **Empirical Methodology**

Over the last decade policy initiatives reduced export delays to stimulate trade. Yet, the logic of a endogenous funding that we propose in the previous section points to delay reductions as a driver of higher export costs that, in turn, hinder trade. In the simplest case, the nexus of these relationships can be summarized by the following system of equations:

$$\begin{aligned} ln\left(\frac{Exp.Costs_{it}}{Exp.Costs_{jt}}\right) &= \alpha + \beta_1 ln\left(\frac{Exp.Delays_{it}}{Exp.Delays_{jt}}\right) + \beta_2 ln\left(\frac{Agg.Exports_{it}}{Agg.Exports_{jt}}\right) \\ &+\beta_3 ln\left(\frac{Corruption_{it}}{Corruption_{jt}}\right) + \beta_4 ln\left(\frac{Political\ Stability_{it}}{Political\ Stability_{jt}}\right) \\ &+\beta_4 ln\left(\frac{Voice\ and\ Accountability_{it}}{Voice\ and\ Accountability_{jt}}\right) + \varepsilon_{ijt} \end{aligned} \tag{1}$$

$$\begin{aligned} ln\left(\frac{Exports_{ikt}}{Exports_{jkt}}\right) &= \alpha + \gamma_1 ln\left(\frac{GDP_{it}}{GDP_{jt}}\right) + \gamma_2 ln\left(\frac{GDPC_{it}}{GDPC_{jt}}\right) \\ &+\gamma_3 ln\left(\frac{Distance_{ik}}{Distance_{jk}}\right) + \gamma_4 ln\left(\frac{Exp.Delays_{it}}{Exp.Delays_{jt}}\right) \\ &+\gamma_5 ln\left(\frac{Exp.Costs_{it}}{Exp.Costs_{jt}}\right) + \gamma_6\left(Landlocked_i - Landlocked_j\right) \\ &+\gamma_7\left(Contiguity_{ik} - Contiguity_{jk}\right) + \gamma_8\left(Colony_{ik} - Colony_{jk}\right) \\ &+\gamma_9\left(Language_{ik} - Language_{jk}\right) + \vartheta_{ijk} \end{aligned} \tag{2}$$

Equation (1) investigates the link between export costs and export delays. Equation (2) explores the combined effect of both such impediments on exports. In both instances we estimate first-difference equations. This approach entails pairing *similar* exporters and regressing ratios of corresponding variables across each pair. Exporters are deemed to be similar if they belong to the same geographical region and generally face the same trade barriers in countries to which they export. [8]

Let $m \in (i, j)$ where $i \neq j$. Beginning with Equation (1), let $Exp.Costs_{mt}$ and $Exp.Delays_{mt}$ denote the aggregate export costs and export delays of country m at time , respectively. The sign and significance of the coefficient of relative export delays is of particular importance to this study as it measures the extent to which innovations that target delay reductions are funded by increases in export fees. Two other factors are likely to play an important role in the determination of export costs. The first is the aggregate volume of exports of any given country to the rest of the world at time $(Agg.Exports_{mt})$. An increase in aggregate exports will increase the demand for resources that are used intensively in the various export channels, which may in turn, increase the government fees that are charged for the use of these channels. The second is the efficiency with which any given government is likely to operate the export process. Efficient governments are those with an established and well operating transportation infrastructure and customs frameworks, which are likely to keep export costs at relatively low levels. We use three variables to proxy government efficiency. These are indexes of corruption $(Corruption_{mt})$, political stability and absence of political violence $(Political\ Stability_{mt})$, and the prevalence of political voice and institutional accountability $(Voice\ and\ Accountability_{mt})$. Certainly in the case of developing countries, which are the focus of this study, absence of corruption and political violence and presence of political stability, political

[8] Each country pair combination with an importer enters our regressions once.

voice, and institutional accountability represent important pillars of government efficiency. We avoid the use of other indexes, such as the World Bank's index of government effectiveness, that are constructed using measures of the incidence of distortive fees such as export costs. Such indexes are endogenous with respect to the dependent variable of Equation (1) and are therefore inappropriate.

The specification of equation (2) follows that of a typical gravity equation in difference form. The gravity model is the most successful and extensively used empirical model in international trade. It predicts the volume of imports and exports between countries with considerable precision and helps identify the factors that may cause deviations from a baseline frictionless bilateral trade relationship. The gravity model owes its name to the Newton's law of gravity. In Newton's law, the gravitational attraction between two objects increases with the product of their masses and diminishes with distance. Similarly, at its most basic form, the gravity model predicts that the volume of trade between two countries increases with the product of their sizes, measured by gross domestic products, and decreases with geographical distance.

Soon after its first formulation by Tinbergen (1962) and almost simultaneously by Pöyhönen (1963) the gravity equation became a workhorse of international trade. It success was driven by both, its consistency in predicting bilateral trade flows based on a simple and compelling formulation and its capacity to explain a significant proportion of the variations in the trade data between countries. Even the first version of the equation estimated by Timbergen in 1962 registered an R^2 of 0.82 and in successive studies its good of fitness would range between 0.65 and 0.95 depending upon the samples (Deardorff 1998). Tinbergen original formulation consisted of a log-log OLS estimation of the bilateral volume of merchandise trade between two countries, where the right-hand-side variables were the size of the importer's economy to measure its demand capacity, the size of the exporter's economy to account for it supply capacity and the geographical distance between them to control for trade frictions, in particular transportation cost. The equation also included a dummy variable equal to unity if the trade partners shared a land border and a dummy variable equal to unity if both countries were part of a preferential trade agreement. The use of the gravity equation in empirical studies in international trade has gone a long way since its introduction, and various innovations have been proposed since then to improve its performance. In particular, by incorporating additional variables to account for factors that may impede or facilitate trade between countries such as, common language, common colonial ties, average tariffs, remoteness,[9] etc.

However, despite the early advances in its empirical formulation and its extensive application, the gravity equation remained as a mere empirical tool with little or no theoretical foundations for almost two decades after its creation. Anderson (1979) was the first in deriving the gravity equation theoretically. His approach was to assume complete specialization where each product variety is produced by a different country. Then, based on identical and homothetic preferences, consumers demand all available product from all countries. Bergstrand (1985) also derived the gravity equation following the complete specialisation approach and then Elhanan Helpman and Krugman (1985) and Helpman (1987), among others, assume monopolistic competition to explain the gravity equation theoretically in the framework of the new trade theory. But soon it became clear that complete specialisation and the new trade theory were not necessary requirements to derive the gravity equation theoretically. Other studies, such as Haveman and Hummels (2004) and Evenett and Keller (2002), found theoretical foundations without assuming complete specialisation, and other core international trade theories also served as the bases for its derivation (e.g., Eaton and Kortum (2001) derive the gravity equation within the framework of the Ricardian model while Deardorff

[9] Remoteness typically refers to the GDP-weighted average of the importer or exporter distance to all of its trading partners (Baier and Bergstrand 2009).

(1998) follows the Heckscher-Ohlin model). Today the gravity equation is considered not only a robust empirical instrument in international trade but also a model with strong theoretical foundations.

The results of our gravity specification (equation 2) have the potential to reverse the narrative advocated by earlier studies regarding the importance of export delays. To impart credibility to these results we follow Rose (2004) and purposefully avoid introducing novelty to the specification, data, or estimation of this gravity equation in difference form. In particular, the dependent variable represents the relative exports of two *similar* countries i and j to the same destination. Letting $m \in (i, j)$, it is constructed using $Exports_{mkt}$ that denotes the value of exported goods from country m to country k at time t.[10] Formulating the regressors follows a similar approach. With the exception of export delays $\left(Exp.Delays_{mt}\right)$ and export costs $(Exp.Costs_{mt})$, the remaining explanatory variables are standard in gravity equations. Let $Distance_{mk}$ denote the distance from exporter m to importer k, and let GDP_{mt} $(GDPC_{mt})$ represent exporter m's gross domestic product (gross domestic product per capita) at time t. In addition, let $Landlocked_m$, denote a dummy that is equal to unity when country m is landlocked, and let $Contiguity_{mk}$, $Colony_{mk}$, and $Language_{mk}$ denote dummy variables that are equal to unity when exporter m and importer k have a common border, common colonial history, and common language, respectively. Finally, ε_{ijt} and ϑ_{ijkt} are the disturbance terms.

Difference gravity models have a number of advantages over competing characterizations and have been used extensively in the literature (e.g., Anderson and Marcouiller 2002; Hanson and Xiang 2004; and Djankov, Freund, and Pham 2010). Some of these advantages rely on how similarity between countries is defined, whereas others are inherent to the differencing

[10] For example, Portugal and Spain exporting to Australia, Argentina and Brazil exporting to Sweden and, Kenya and Malawi exporting to Colombia.

process. We discuss them in this order, while paying particular attention to how the specific criteria that we use to define similarity (i.e. geography and trade barriers) give rise to the benefits of this approach. We begin with the criterion of a common geographical region. This criterion is important for three reasons. First, its use in the context of a difference equation facilitates controlling for importers' and exporters' remoteness which, as highlighted by the work of Anderson and Wincoop (2003), play an important role in trade. Of course, remoteness can also be controlled in level gravity equations using an index of multilateral resistance. However, the calculation of such indexes can be a complicated proposition and their accuracy has been a subject of considerable debate (Behrens, Ertur, and Koch 2012). Second, reliance on geography to define similarity disentangles the dual role of distance in gravity equations. The original and principal role of this variable is, of course, to account for transportation costs between exporters and importers. However, in a recent important contribution Melitz (2007) shows that latitudinal distance has a profound effect on climatological and natural conditions which, in turn, impact on optimal production techniques, the productivity of different factors and – assuming comparable levels of development – relative factor endowments. These differences increase opportunities for profitable trade. Hence, an increase in latitudinal distance has a dual effect. It increases transportation costs hindering trade, but also increases production differences that promote trade. By pairing countries that belong to the same geographical region (while controlling for their level of development) and examining their relative distance to a common importer our model controls for the extent to which distance may capture production differences that may promote comparative advantage. Third, combining common geographical region while controlling for the level of development reduces the prevalence of endogeneity bias. Not only are export delays and export costs expected to impact on exports but the reverse is also possible. Djankov, Freund, and Pham (2010) argue that by pairing similar countries that are likely to have similar exporting infrastructures, and therefore similar capacities to respond to changes in the demand for resources used in export channels, the difference approach partly neutralizes the impact that comparable perturbations on exports have on export delays. Of course, the same logic that applies to the case of delays must apply to export costs. Still, the difference approach may not completely eliminate endogeneity bias in either case. For this reason our estimations also include an instrumental variables approach which we discuss in some detail in a forthcoming section.

Consider now the criterion of common trade barriers. We implement this criterion by requiring any two countries to belong to the same regional agreement before they are deemed to be similar. Using this criterion to define similarity and expressing the dependent variables in terms of relative exports to a common importer accounts for the fact that custom union members are typically treated symmetrically by third parties. In this light, this approach nets out importers' tariffs and non-tariff barriers, which are notoriously difficult to measure. In addition, this approach nets out trade factors that are specific to the importer and can have an important impact on trade. These include the importer's population, GDP, and so on.

1.3. **Data**

The econometric analysis requires data on trade flows, trade blocs, export transaction costs, the quality of governance and institutional performance, national income accounts, and various geographic and historical country characteristics.

Trade data, in nominal US dollars, was collected from the *United Nations Commodity Trade Statistics Database (UN Comtrade)*. Trade bloc membership information was kindly provided by Djankov, Freund, and Pham (2010). Export transaction costs, in the form of time delays and pecuniary costs, were collected from the World Bank's Doing Business - *"Trading Across Borders*" survey. This survey has been administered annually since 2005 to freight forwarders, shipping lines, custom brokers, and banks in over 140 countries. The survey includes questions on export delays from its inception, whereas questions on export costs were first introduced in 2007. To make the data comparable across economies survey questions concentrate on goods with common characteristics. In particular, they pertain to goods that may travel in a dry-cargo, 20-foot container that weighs 10 tons, and is valued at $20,000. Such goods exclude military items, are not hazardous, do not require refrigeration or special phytosanitary or environmental safety standards, and represent one of the economy's leading export products. In addition, such goods must be produced by a business that employs at least 60 employees, is located in the economy's largest business city, is a private limited liability company, does not operate in an export processing zone or an industrial estate with special export or import privileges, is entirely domestically owned, and exports more than 10% of its sales.

The survey collects information regarding four distinct types of export delays and pecuniary export costs. They correspond to the time required and the monetary expense that are incurred in: (i) preparing and submitting the requisite export documents to the appropriate government authorities and financial institutions, (ii) subjecting a shipment to custom inspections and fulfilling the various requirements for customs clearance, (iii) arranging inland transportation, loading shipment on mode of transportation, and transporting it from warehouse to seaport (or, in the case of landlocked countries, to border); and (iv) handling a shipment within the port. This last item entails waiting delays before the designated vessel for any given shipment departs and the time required to load containers onto the vessel in conjunction with a variety of associated terminal charges. Costs do not include destination tariffs, charges associated with international transportation, or bribes.

The endogenous relationship between delays and costs that is discussed in earlier sections is not likely to be equally prevalent across these categories. Consider for example the case of export documents. Typically, the submission of each such document must be accompanied by a prescribed government fee. Cutting down on bureaucracy by, say, eliminating some of these documents can decrease associated time delays and is not likely to represent a costly exercise (WTO 2006, 52).[11] However, this does not necessarily imply the elimination of associated submission fees. In most instances we would expect governments to choose revenue-neutral policies by requiring the total revenue generated from document submission fees to remain unchanged.

Unlike the case of export documents, reducing delays associated with domestic transportation from factory to port, which could be accomplished by building better road networks, is likely to be exceptionally costly. Furthermore, such costs may very well be passed on to all users of such networks, including exporters. However, to the extent that such infrastructure projects are in fact taking place around the world, their completion is likely to take a long time and we do not expect their results to be fully captured by the short time span that we examine.

Of particular interest to our study are delays and costs associated with clearing goods through customs and ports – categories (ii) and (iv) above. According to the experience of a number of developing countries around the world, reducing time delays associated with these channels can be achieved with relative ease by hiring more custom inspectors, establishing custom inspection priority channels (that can issue advance ruling and release of express shipments), forming "enquiry points" that disseminate customs information, streamlining terminal procedures, expanding terminal holding areas, introducing automation in processing shipments at national ports,

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[11] For example, a number of countries have recently eliminated the requirement of a packing list, certificate of origin, export license, inspection report, and technical and health certificate. Collecting such information is either entirely unnecessary or replicated in the customs export declaration that most nations require (*Doing Business*, 2010).

increasing the number of dockside gantry cranes that are used to load containers on ships, and so on (United Nations 2006). The preponderance of such innovations can be introduced within a very short time span but they come at significant establishment costs and – perhaps more importantly – ongoing operational costs (United Nations 2006; Yasui and Engman 2009; WTO 2005a; WTO 2005b). For reasons advocated in earlier sections, and highlighted in Chapter 2 by our theoretical model, such costs are likely to be passed on to exporters rather than any given government's general ledger and we expect the ensuing relationship between delays and costs to manifest in our results. In light of these considerations, and to simplify the analysis, we merge categories (ii) and (iv) pertaining to custom and terminal channels, on the one hand, and categories (i) and (iii) corresponding to documentation and transportation procedures on the other. For consistency and to be able to link the results obtained from estimating equations (1) and (2) we also incorporate this level of disaggregation to the estimation of our gravity equation.

Our econometric analysis relies on data from 2006 to 2011 that was collected by the World Bank's Doing Business - *"Trading Across Borders*" surveys conducted from 2007 to 2012. Given the significant extent to which this data is typically revised in the first 2 years after it is published, we avoid using more recent surveys. Table 1.2 provides descriptive statistics of aggregate export delays and export costs by trade bloc.

We measure the quality of governance and institutional performance using indexes of political stability, voice and accountability, and corruption. Indexes of political stability and voice and accountability were collected from the World Bank's *Worldwide Governance Indicators*. The former measures perceptions of the likelihood of political stability and absence of politically motivated violence. The latter captures perceptions of the extent to which a country's citizens are able to participate in selecting their government, consider their media to be free, and have freedom of expression and association. Both indexes range approximately from -2.5 to 2.5 and increase monotonically with positive perceptions. The third measure of institutional performance that we employ is an index of corruption, which was collected from the database of *Transparency International*. The index assumes values between 0 and 100 and is *inversely* related with the prevalence and intensity of corruption.

GDP and GDP per capita were collected from the World Bank's *World Development Indicators*. The remaining data corresponds to trade friction indicators that are fairly standard in gravity equations. Our measure of the distance between trade partners corresponds to the geodesic distance calculated using the great circle formula, which uses latitudes and longitudes of the most important cities and population agglomerations. This measure of distance and the information needed to construct dummies corresponding to common border, language, and colonial history between trade partners were all collected from the (*Centre d'Etudes Prospectives et d'Informations Internationales* (CEPII).

Our panel includes data for 114-119 countries for 2006-2011. The small differences in the number of countries that appear in our panel from year to year are the result of data availability constraints. On average, about 65% (35%) of these countries are classified as developing (high income). Table 1.3 provides descriptive statistics of all variables used in this study.

1.4. **Estimation and Results**

To impart credibility to our results we avoid the introduction of novelty in our estimation approach and follow the convention of estimating the gravity equation – in our case, equation (2) – independently of other equations that may determine its regressors. Following this approach will help establish the precise source of any differences between our findings and those of related studies that rely on similar gravity formulations. In any event, given that the dependent variable in (2) is not present in (1), this system of equations is not eligible for simultaneous estimation. In the current context, this is not necessarily a disadvantage. Independent estimation of (1) and (2) guards the latter against transmission of specification bias that is likely to derive from our, inescapably *ad hoc*, choices for proxies of government efficiency in equation (1).[12]

Consider now Equation (1). Following the discussion of a previous section, this equation may be used to investigate whether there is empirical support for the hypothesis that innovations implemented by developing countries for the purpose of introducing reductions in certain types of time delays are typically funded by increases in corresponding export fees. A number of nations are on record for expressing a preference for this funding approach (WTO 2005a; WTO 2005b), and our theoretical model in Chapter 2 provides a plausible explanation for such a preference. Interestingly, while funding decisions *within* developing countries can explain a negative link between certain delays and their corresponding pecuniary export costs over time, physical and institutional factors predict the opposite relationship between such variables *across* countries. As recently explained by Clark, Dollar, and Micco (2004) port inefficiencies and the general condition of countries' trade infrastructure are historically responsible for introducing a concomitance of significant trade delays and large pecuniary shipment handling costs. Using 1998 figures these authors provide tentative evidence along these lines by comparing the efficient, fast, and low fee ports of East Asia with their inefficient, slow, and high cost counterparts of Latin America. However, due to significant data deficiencies the authors are not able to extend their analysis to the majority of developing countries (including African countries) which, as we show in Table 1.2, are an important part of the story.

[12] It may be instructive to recall that 3SLS and 2SLS are asymptotically equivalent and that the former is more efficient only under the null of no misspecification (Hausman 1978).

To set the scene for an investigation of the relationship between costs and delays within countries, that is at the heart of this study, we first consider the composite of cross-country and time-series correlations between these variables. Using data for all countries during 2006-2011 and the aggregations discussed in a previous section, we calculate the logarithms of real document and transportation costs $(logDTCosts)$, real customs and terminal costs $(logCTCosts)$, document and transportation delays $(logDTDelays)$, and custom and terminal $(logCTDelays)$ delays. We compute the correlation coefficient between $logDTDelays$ $(logCTDelays)$ and $logDTCosts$ $(logCTCosts)$ as well as regress the former on the latter. The results of these naïve panel estimations are reported in Table 4. As it may be noted, the correlation between costs and delays across all categories is positive. This result provides support for the explanations of Clark, Dollar, and Micco (2004). Yet, it is not incongruous with a possible negative causal relationship between costs and delays within individual countries. If such a negative relationship does in fact manifest in the data, it is overshadowed in Table 4 by the positive cross-country correlations.

Estimating (1) with fixed effects for individual pairs of exporting countries disentangles the within country over time variation from the cross sectional link between costs and delays. In addition, unlike the naïve regressions of Table 1.4, estimation of (1) realizes the benefits of the differencing approach discussed in an earlier section and accounts for the determinants of export costs other than delays. Following the aggregations discussed earlier, we estimate two different interpretations of (1). The first links document and transportation delays and costs and the second custom and terminal delays and costs.

The ratio of aggregate exports is of particular interest. Not only do we expect changes in exports to impact on export costs in any given country, but the reverse must also be true. For reasons discussed in an earlier section, the endogeneity bias that may derive from such reverse causation is partly ameliorated by the differencing approach. To further address the possible prevalence of such bias we also instrument the ratio of aggregate exports. Following the logic of the gravity model the instruments we use are three key determinants of this variable: the ratio of exporting countries' GDP, GDP per capita and aggregate distance to all respective trade partners.[13] The statistical validity and correct exclusion of these instruments from the estimated model is also examined by conducting an overidentification test which we report in Table 1.5.[14]

The logic of the mechanism that we examine in this study links changes in delays that may be compelled by international agreements *over time* to changes in costs *over time*.[15] In this light, we examine (1) not only in level (of ratios) but also in time difference (of ratios) that may better capture the

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[13] $Agg.Distance_{mt}$ represents exporter's *m* sum of the distance in kilometers to all its trading partners at time *t*.

[14] The Overidentification test used in our estimations corresponds to the *Sargan-Hansen J statistic*, where the joint null hypothesis is that the instruments used in the estimation are valid instruments, i.e., uncorrelated with the error term, and that the excluded instruments are correctly excluded from the estimated equation. All *P-values* reported in Table 1.5 indicate that the null hypothesis that the instruments are valid and correctly excluded from the estimated equation cannot be rejected.

[15] Various countries, potentially following the recommendations of International Organisations, have already implemented trade facilitation policies with particular focus on reducing delays, as shown in table 1.1. In addition, the WTO members have successfully concluded negotiations on a Trade Facilitation Agreement at the Bali Ministerial Conference in 2013. The Agreement will enter into force once two-thirds of the countries have completed their domestic ratification processes.

relevant within country variation.[16] In each case we use data for all countries, as well as independently for high income and developing countries. In all instances we report errors that are robust in the presence of arbitrary heteroskedasticity. The results appear in Table 1.5.

Consider first the results corresponding to the determination of custom and terminal costs in the case of developing countries. They are found in the rows of Panel B, columns (3) and (4). Beginning with the measures of governance quality we note that two of the three relevant indexes (*Political stability* and *Voice and accountability*) switch signs across the level and time difference regressions. In addition, only one of the four relevant coefficients of these two variables (in columns 3 and 4) is statistically significant. By contrast the corruption index is negative and statistically significant in both columns. This suggests that, in accordance with *a priori* expectations, higher levels of corruption, are consistent with greater the export costs.[17] Also consistent with expectations is the coefficient of aggregate exports which is positive and statistically significant. As exports increase the demand for resources required to process them also increases driving export costs to higher levels. Finally, the coefficient of delays is negative and significant at the 1 and 5 percent levels in the time difference and levels regressions, respectively. This provides strong support for the mechanism envisaged in this study and has important implications. Of course, this negative relationship does not manifest in the case of corresponding regressions that examine the determination of documents and transportation costs and delays where, as we already discussed in an earlier section, the prospect of such a link is tentative. In addition, it also fails to

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16 In the time difference estimation approach we first difference all variables in the model (by calculating the period-to-period change) before implementing fixed effects.

17 Recall that *Transparency International*'s index of corruption increases *inversely* with the level of corruption.

manifest in the case of high-income countries where, as we show in Table 1.1, export delays have remained virtually unchanged over the period under examination. We will not discuss the remaining results that are reported in this table. They are provided here only in the interest of completeness. In any event, casual perusal of these results affirms that they are broadly consistent with expectations.

The key objective of estimating Equation (2) is to investigate the relative role of export costs and delays in export decisions. This entails a small number of specific deviations from the estimation approach of earlier studies in this area. In addition to omitting export costs from the analysis altogether, such studies typically abstract from a detailed discussion of different types of delays, and rely exclusively on cross-country data (see for example Djankov, Freund, and Pham 2010). How such estimation frameworks must be modified in this study is guided by our findings so far. There are three key lessons that may be drawn from such findings. First, in any given country different types of export delays may have different within country relationships with their corresponding export costs. Second, the nature of such links is likely to be different across developing and high-income countries. Third, at least in the case of developing countries, the relationship between particular export costs and their corresponding export delays *within countries* over time can be orthogonal to the analogous link *across countries* for any given year.

To clarify the relevance of each of these considerations and to bridge the gap between the important contributions of earlier work, on the one hand, and the contribution of this study, on the other, our estimation strategy unfolds in a series of steps. For presentational convenience we denote these steps Models 1, 2, and 3. Each successive model adds a specific layer of complexity to the analysis and sheds progressive light on the precise role of export costs and export delays in export decisions.

We begin with Model 1 that is a cross-country interpretation of Equation (2) using data for 2009 which is at the midpoint of our time series.[18] We estimate this model for all countries as well as independently for high-income and developing countries. In each case, we estimate two specifications. The first is in line with earlier formulations that include aggregate delays but exclude aggregate export costs. The second adds aggregate export costs to the regression. All regressions cluster observations by pairs of exporters, and all reported standard errors are robust to the presence of arbitrary heteroskedasticity. In addition, export delays and export costs are instrumented with their first lags as well as the number of custom inspections of imports[19] and our indexes of corruption, political stability, and voice and accountability. The results are given in Table 1.6.

We first consider the coefficients of variables that are standard in comparable formulations that may be found in the literature. Distance is, of course, ubiquitous in such formulations given that it is a central concept in the development of the gravity approach. The coefficient of this variable for the subset of our regressions that rely on data for all countries (columns 1 and 2) is about -1.3 and statistically significant at the 1 percent level. This is in line with the overwhelming majority of relevant studies that, according to the

[18] Global trade was severely affected by the Global Financial Crisis in 2009. However, given that the fall in trade was global in nature and mostly consistent across regions (Levchenko, Lewis, and Tesar 2010) we do not expect our estimations results to be affected in any particular way during this year. This expectation is supported by the fact that pooled estimations (using the whole period 2006-2011), reported later in this chapter, show identical qualitative results.

[19] This variable, which represents the total number of average customs inspections to imported cargos conducted by each exporter in 2005, is from Djankov, Freund, and Pham (2010).

recent survey of Disdier and Head (2008), find this coefficient to assume values under 1.55. Also in accordance with similar studies, we find the coefficient of Distance to be generally higher in the case of developing exporters than their high-income counterparts. As predicted by theory, and as empirically supported by the relevant literature (see Carrère (2006) for key references), our coefficient of GDP is around unity for all specifications. Also in accordance with expectations, and similarly to other studies that use comparable data (e.g., Rose 2004), the coefficients of GDPC, Language, and Colony are positive in the case of all specifications and, in most cases, statistically significant at the 1 percent level. By contrast coefficients for Landlocked and Contiguity exhibit sign reversals across developing and hig-income countries. At least in the case of Landlocked none of the estimated coefficients corresponding to the various specifications are significant. However, in the case of Contiguity it is troubling that the relevant coefficient is negative and significant in the specifications for high-income countries (columns 5 and 6). One potential explanation for this result may rely on the fact that a relatively large fraction of the volume of trade across high-income countries occurs within trade blocs, in which other members tend to also be high-income countries. Within these trade blocs not sharing a common border with a trade partner may not constitute a significant obstacle to trade, rendering the coefficient on contiguity either statistically insignificant or even with a negative sign. For example, a significant fraction of trade of countries belonging to the EU occurs with other members, where common borders are not expected to have a significant impact. To test this potential explanation I estimate equation (2) for high-income countries excluding observations of European Union (EU) country pairs when two conditions are met. First, one of the exporters in the pair shares a border with the common importer while the other does not. Second, the common importer also belongs to the EU. These observations correspond to 1.33% of the total number of observations in 2009 (Table 1.6 columns 5 and 6). As expected, although statistically insignificant, the contiguity coefficient reverts its sign back to positive. All other results are qualitatively unchanged.

Finally, we turn our attention to the key variables of export delays and export costs. Consider first the specification of column (1) which relies on data for all countries and is intended to replicate the results of earlier studies, such as Djankov, Freund, and Pham (2010), that only consider the role of delays using 2005 data. Our estimated coefficient for this variable using 2009 data is -0.633 which is comparable to these authors' 2005 figure of -0.484.[20] The specifications of columns (3) and (5) disentangle the corresponding coefficient for developing countries, on the one hand, and high-income countries, on the other. As it may be noted from Table 1.6, the former is -1.628 and the latter -0.320. We set aside an interpretation of the difference in these coefficients which, in any event, is broadly consistent with those of similar contributions.[21]

Having effectively replicated the results of earlier studies that only consider delays, we proceed to the results of regressions that also include export costs. These are given in columns 2, 4, and 6 of Table 1.6 in the case of all countries, developing countries, and high-income countries, respectively. Central to our analysis is how the coefficient of export delays changes when export costs are added to our regressions. We can, of course, infer the likely

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[20] For comparison see Table 2 of Djankov, Freund, and Pham (2010). Data sources for trade, export delays, GDP and GDP per Capita, as well as the rest of the standard gravity equation variables used by Djankov, Freund, and Pham (2010) were obtained from the same data sources used in this study.

[21] See for example the various specifications estimated by Djankov, Freund, and Pham's (2010) outlined in their Tables 2 and 3. Note in particular their estimates for the coefficient of delays in the case of landlocked countries – which are primarily developing nations (Faye *et al.* 2004) – with their estimates of this coefficient in the case of all countries.

direction of such change. Given the positive cross sectional correlation between delays and costs, which may be inferred from the results of Table 1.4 and 1.5, we expect the absolute value of the coefficient of delays to decrease with the addition of costs[22]. However, we have no *a priori* expectation regarding the extent of such a decrease. Consider first the case of developing countries. As it may be noted from table 1.6 the coefficient of export delays declines (in absolute value) from a figure of -1.628 that is statistically significant at the 5 percent level, to a statistically insignificant figure of -0.654. At the same time the coefficient of export cost is -1.64 and statistically significant at the 5 percent level.[23] These findings are staggering. They suggest that earlier studies inflate the role of export delays and highlight the important, yet previously neglected, role of export costs in the developing world's export decisions. To place these coefficients in perspective, consider the average size of export costs and bilateral exports for developing countries in 2009. These were $1,426 and $333.4 million, respectively. Given these figures our regression estimates suggest that, other things equal, a 10 percent reduction in export costs from $1,416 to S1,274 can increase bilateral trade by an average figure of almost $55 million. Delays, of course, remain an important impediment to trade. Other things equal, a 10 percent reduction in time delays would generate on average an additional $21 million of bilateral trade. However, this is only about 40 percent of the impact identified by earlier

[22] In 2009 the correlation between export delays and export pecuniary costs in developing countries is 0.4815.

[23] The significant change in the coefficient of export delays after including export pecuniary costs in the estimation may raise some concern about a potential multicollinearity issue in the estimation of these coefficients. To test for multicollinearity we estimate the Variance Inflation Factor (VIF) for both export delays and export costs. The VIF for these estimators is 2.11 in both cases, indicating no multicollinearity in our regressions.

studies. In this light, our results suggest that the developing world's monolithic approach to trade liberalization that, as suggested by Table 1.1, has so far concentrated almost exclusively on delays is unsound. Accounting for the endogeneity between costs and delays (which we undertake at a later point) can only strengthen such an assessment.

Contrary to the case of developing countries, adding export costs to the regressions of high-income exporters appears to have virtually no impact on the coefficient of delays. From a value of -0.320, that is statistically significant only at the 10% level, this coefficient decreases (in absolute value) to a value of -0.269 that is statistically insignificant. It is also important to note that the coefficient of export costs that assumes a value of -0.141 and is statistically insignificant, is only about one tenth as large as the corresponding coefficient in the case of developing countries.

The important difference in the relative role of export delays to export costs in the trade decisions of developing and high-income countries merits further examination. Why is it that a 1 percent reduction in costs matters more than a 1 percent reduction in delays in developing countries than it does in high-income countries? The answer relates to the fact that export costs are, for the most part, a *fixed* expenditure on any given shipment. By contrast, the financial implications of time delays – that are largely due to depreciation – are *ad valorem*. Consider now that in 2009 the average export costs (delays) in high-income countries were $1,027 (12 days) and in developing countries $1,416 (23 days). Given these figures, a sufficiently large difference in the value of the average shipment originating from high-income countries, on the one hand, and developing countries, on the other, could readily explain our estimates. By way of an illustration assume that the value of the former is, say, $10,000 and the latter $5,000 and that the daily cost that results from export delays of a shipment is in the order of 1 percent. Given these figures, a 10% reduction in the export costs (export delays) of high-income countries corresponds to $103 (a monetary cost of $120). By contrast, a 10% reduction in the export costs (export delays) of developing countries corresponds to $142 (a monetary cost of $115). Dividing export cost by the monetary cost of export delays corresponds to 0.86 and 1.2 for high-income and developing countries, respectively. Clearly, reductions in export delays (export costs) matter more than comparable reductions in export costs (export delays) to high-income (developing) countries if the value of the average shipment of high-income countries is sufficiently larger than the value of the average shipment of developing countries. In this example we relied on hypothetical shipment value figures because data on the value of goods that are exported in standard 20 foot containers by different countries is not readily available. Still, in an effort to shed some relevant light, we were able to collect data from the U.S. Department of Commerce on the average value per kilogram of all 2 digit level Harmonized commodity categories that are exported by various countries to the United States during 2009. Using this data we calculated the value of the average kilogram of goods exported by each country. corresponding to each Harmonized category of exports. We then disaggregated the 119 countries in our sample into high income and developing groups and generated corresponding averages. These figures are reported in Table 1.7. As it may be noted from this table, the value of the average kilogram of containerized exports of high-income countries to the U.S. is significantly larger – almost twice – that of developing countries. If we assume that the average kilogram of any given origin requires the same physical space within a standard 20 foot container, then, containerized exports from developing countries are likely to be worth half as much as those from high-income countries. This is perfectly consistent with the figures used in our earlier example.

To investigate the extent to which our findings for 2009 are representative of cross-country regressions for other years we ran independent cross-country regressions for all years in the 2006-2011 period. We also ran a series of pooled regressions for the same country subsamples considered in Table 1.6. We refer to these collectively as Model 2. In the interest of brevity we only report the estimated coefficients of our pooled regressions that, crudely speaking, represent a form of a weighted average of the cross-country coefficients for individual years.[24] The estimation approach is similar to what was used in the case of the regressions of Table 1.6. These results are given in Table 1.8. As it may be noted, the estimated coefficients are, for all practical purposes, virtually identical to those of Table 1.6.[25]

The purpose of estimating equation (2) using 2SLS is to correct for the potential endogeneity bias on the coefficients of export delays and pecuniary costs that may be produced by reverse causality with the volume of exports. Higher export may create bottlenecks, for example at the ports, that would increase delays and possibly, pecuniary costs, resulting in a positive bias on their respective coefficients. However, in the case of delays it could be argued that the reverse causality may take different forms depending on the established export infrastructure and response capability of individual countries. With poorer infrastructure and limited available resources developing countries are more likely to experience bottlenecks when exports

[24] This statement should be interpreted with care. It can be shown that under certain conditions pooled sample coefficients are not bounded by the values of the cross-sectional subsample coefficients.

[25] Similar to the cross-sectional estimations reported in Table 1.6, the negative coefficient on Contiguity for high-income countries reported in Table 1.8 (columns 5 and 6) may also be explained by the relatively high volume of trade within trade blocs between high-income countries. To test this explanation we follow the same approach described for Table 1.6. The results of this estimation show that in the case of the pooled regression the Contiguity coefficient does not only revert its sign to positive but it also becomes statistically significant at the 5% significance level. As in the cross-sectional case, the coefficients on the rests of the independent variables do not change qualitatively.

increase, which would raise delays, producing a positive bias in our coefficient. On the other hand, the effect of high export volumes in high-income countries is more likely to go in the opposite direction. Counting with good export infrastructure, more available resources and better response capability high-income countries may be able to quickly react to higher exports volumes by allocating the necessary resources to reduce delays. As a result, in this case higher exports are more likely to lead to lower delays.

To investigate the direction of the bias in our estimations we also ran the regressions reported in Tables 1.6 and 1.8 for developing and high-income countries using simple OLS. Table 1.9 shows the results of the specifications where both, export delays and export pecuniary costs are considered. When using OLS the coefficient on delays for developing countries is positive in both, cross-sectional and pooled estimations (specifications (1) and (2) respectively). As expected, this suggests a strong positive endogeneity bias in developing countries. Implementing 2SLS in Tables 1.6 and 1.8 addresses this issue. Similarly, the negative coefficient on export pecuniary costs is larger when using 2SLS, suggesting a positive bias in the OLS specification. On the other hand, the direction of the bias on the coefficient of delays in high-income countries reported in columns (3) and (4) is negative. Consistent with our expectations, higher exports leads, on average, to lower delays in high-income countries. As a consequence, instrumenting export delays results in a smaller negative coefficient. In the case of pecuniary costs the OLS coefficient is negative and barely statistically significant in the cross-sectional regression and statistically insignificant in all other specifications using either OLS or 2SLS.

The objective of our final set of regressions, which we denote Model 3, is twofold: First and principally, to examine the extent to which documents and transportation impediments, on the one hand, and customs and terminal handling impediments, on the other, play different roles in export decisions.

Second, to investigate such roles in a setting that accounts for the within country endogeneity of export costs.

The interplay between export costs and export delays is particularly important in the case of developing exporters. There are three reasons for this. First, because the developing world is the foremost driver of reductions in export delays during the years under examination (Table 1.1). Second, because both on the basis of statements made by developing countries (e.g., WTO 2005a, 2005b) as well as statistical evidence (Table 1.5) it appears that the innovations that make delay reductions possible are funded by increases in export cost. Third, because the introduction of export costs in gravity equations that previous studies used to study delays has a particularly profound impact on the significance of such delays in the export decisions of developing but not high-income countries (Tables 1.6 and 1.8). For these reasons Model 3 concentrates on developing exporters. We estimate this model both without and with fixed effects – with the former serving as a bridge with earlier estimations. In each case, we estimate two specifications. As in the case of Models 1 and 2, the first includes export delays but excludes corresponding export costs. The second adds export costs to the regression. All four specifications are estimated using 2SLS where the various types of export delays and costs are instrumented with their second lags as well as the number of custom inspections of imports and the indexes of corruption, political stability, and voice and accountability discussed earlier. In addition, all regressions cluster observations by pairs of exporters, and all calculated standard errors are robust to the presence of arbitrary heteroskedasticity. Results are reported in Table 1.10. Consider first specification (1). The coefficients of both custom and terminal handling (CT) delays as well as documents and transportation (DT) delays are negative – with the former being statistically significant at the 1 percent level. Consistent with our earlier findings, adding the corresponding export costs in specification (2) causes a decrease in the absolute value of the coefficients of both types of delays. In addition, it renders both statistically insignificant. We forgo a discussion of possible sources of differences in the coefficients of CT delays (costs) and DT delays (costs) which, with a single exception, are statistically insignificant.[26]

Finally, consider specifications (3) and (4). Note that switching from a pooled regression (specification 1) to a fixed effects regression (specification 3) does not have a qualitative impact on the coefficients of CT and DT delays, which are in both instances negative.

From Table 1.5 we know that CT (DT) delays relate negatively (positively) with CT (DT) costs *in the representative developing country over time*. Hence, at least qualitatively, the coefficients of delays will change in a more or less predictable manner as we progress from specification (3) that does not include export costs to specification (4) which does. In particular, the addition of export costs in (4) is expected to increase (decrease) the absolute value of the negative coefficient of CT (DT) delays estimated in (3) and hence render CT (DT) delays to matter more (less) in export decisions. Despite such qualitative predictions the precise quantitative impact on the coefficients of CT and DT delays is unknown, and at least in the case of the former it is particularly important because it has the potential to reverse the main finding of this paper so far: that delays play a secondary role to costs in export decisions. In other words, given the results of Table 1.5, specification (4) of

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[26] As showed by Pham, Lovely, and Mitra (2014), when regressions are in difference form the inclusion of a constant term may yield very different results depending on which country is chosen to be in the numerator (i.e. exporter *i*) and which country is chosen to be in the denominator (i.e. exporter *j*). For this reason, as a robustness test we also run all non-fixed effects regressions reported in tables 1.6, 1.8 and specifications (1) and (2) in table 1.10 excluding the constant term. As expected, given that in all these regressions the constant term is not statistically different from zero, no significant changes are observed in the results.

Table 1.10 provides the best possible setting for the coefficient of CT delays to assume a large negative value. It does not. This coefficient remains virtually the same as in specification (3) (-0.683 versus -0.625) and is statistically insignificant in both specifications. At the same time, the coefficient of DT delays decreases substantially from -2.043, and significant at the 10 percent level, to 0.626 and insignificant. Similarly to delays, DT costs appear to have a very small effect on exports, with a coefficient of -0.131 that is statistically insignificant. By contrast, and similarly to what we found in the case of pooled regressions, CT costs – with a coefficient of -1.67 that is significant at the 5 percent level – are found to play an important role in export decisions.

The results reported in Table 1.10 specification (4) in combination with our findings in relation to the impact of delays reductions on pecuniary export costs presented in Table 1.5 (specification 4) suggest that, in developing countries, implementing policies to reduce export delays may result in a net negative impact on trade. A simple calculation shows from Table 1.5 that a 10% reduction in CT delays produces a 1.64% increase in CT costs on average (Panel B column 4), which from Table 1.10 specification (4) implies a 2.74% decrease in exports (1.64x1.67). Putting these results in context, on average, a 10% reduction in CT delays implies a reduction of $6,695,724 in bilateral exports.[27]

1.5. **Conclusion**

The main message of our estimations can be summarized simply. Contrary to the developing world's emphasis on delays, they appear to play a secondary role to export costs. The latter seem to be the ultimate driver of

[27] The effects of a reduction in DT delays on DT costs as well as on trade are statistically insignificant, Table 1.5 (Panel A column 4) and Table 1.10 specification (4), respectively.

export decisions and, as such, should be at the core of any future trade facilitation efforts.

1.6. **Tables for Chapter 1**

TABLE 1.1 – SUMMARY OF TRADE REFORMS DURING 2006-2010

	Countries in sample	Counties that undertook reforms	Area of reform				Objective of reform	
			Document preparation	Customs	Transportation	Terminal handling	Delays reduction	Cost reduction
Developing	93	51	22	43	4	18	37	4
High Income	29	8	3	6	1	1	3	0
Total	122	59	25	49	5	19	40	4

Notes: A selection of countries undertook simultaneous reforms in a number of areas and not all countries that undertook reforms stated their objective. Hence, the figures in the third column from the left need not correspond to either the sum of the columns under “Area of reform” or those under “Objective of reform”.

TABLE 1.2 – DESCRIPTIVE STATISTICS OF TRADE DELAYS AND TRADE COSTS BY GEOGRAPHIC REGION (2006-2011)

	Delays				Costs				
	Mean (1)	SD (2)	Min (3)	Max (4)	Mean (5)	SD (6)	Min (7)	Max (8)	Countries (9)
Africa and the Middle East	23.9	11.5	7	60	1,218.6	729.9	436.6	5,051.2	42*
COMESA	32.1	12.2	10	60	1,775.2	727.8	657.0	3,725.5	9
CEMAC	33.6	13.8	23	57	2,159.1	1,665.1	975.3	5,051.2	2
EAC	28.3	5.0	18	38	1,808.5	646.9	1,018.7	2,934.5	3
ECOWAS	25.5	8.2	12	45	1,230.9	477.4	605.4	2,192.3	9
EUROMED	15.7	4.3	10	26	768.4	224.5	450.8	1,558.1	9
SADC	28.3	11.0	10	53	1,430.5	530.6	657.0	2,625.2	8
Other	22.3	14.4	7	53	961.5	670.4	436.6	3,017.3	9
Asia and the Pacific	16.5	7.9	6	49	677.1	254.4	368.6	1,781.5	21
ASEAN	16.0	6.4	6	37	555.9	119.5	393.2	822.7	6
CER	9.5	0.5	9	10	860.0	121.1	685.2	1,112.4	2
SAFTA	23.5	6.8	16	41	801.0	352.0	486.7	1,781.5	6
Other	14.3	7.9	6	49	637.4	223.0	368.6	1,753.1	7
Europe	15.6	11.5	6	89	1,086.3	459.5	444.2	3,258.4	39
CEFTA	17.9	3.0	13	25	1,038.3	218.2	632.9	1,484.1	7
CIS	33.9	20.2	15	89	1,931.5	584.1	1,167.2	3,258.4	7
EFTA	9.0	2.0	8	14	1,139.7	255.2	631.3	1,424.8	3
ELL FTA	9.3	2.6	6	13	671.7	103.7	472.6	806.5	3
EU	10.8	4.3	6	20	903.1	220.4	444.2	1,229.2	14
Other	17.6	4.3	10	26	1,085.0	182.0	659.0	1,321.0	5
Western Hemisphere	17.1	8.8	6	49	1,127.2	398.5	425.3	2,400.9	20
Andean Community	23.7	11.4	12	49	1,375.3	584.4	509.3	2,400.9	4
CACM	20.3	6.1	14	36	996.2	242.4	510.4	1,729.8	4
MERCOSUR	19.2	7.9	12	36	1,178.2	300.6	611.2	1,974.4	4
NAFTA	8.8	2.8	6	13	1,232.8	233.6	907.3	1,585.2	3
Other	15.1	5.3	8	35	849.1	271.7	425.3	1,368.0	5
Total Sample	18.3	11.1	6	89	1,054.6	546.9	368.6	5,051.2	122

Source: The table was constructed using data from the *Doing Business* reports of the World Bank and the International Finance Corporation.

Notes: Costs are expressed in constant 2005 dollars. *Seven African countries belong to more than one regional trade agreement: Kenya in COMESA and EAC, Malawi, Mauritius, Namibia, and Zambia in COMESA and SADC, Uganda in COMESA and CEMAC, and Tanzania in EAC and SADC). Africa and the Middle East include COMESA (Burundi, Kenya, Madagascar, Malawi, Mauritius, Namibia, Rwanda, Uganda, and Zambia), CEMAC (Cameroon and Central African Republic), EAC (Kenya, Tanzania, and Uganda), ECOWAS (Benin, Burkina Faso, Côte d'Ivoire, Ghana, Guinea, Mali, Nigeria, Senegal, and Togo), EUROMED (Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Syria, Tunisia, and Turkey), SADC (Botswana, Malawi, Mauritius, Mozambique, Namibia, South Africa, Tanzania, and Zambia), and other (Guyana, Iran, Kuwait, Oman, Saudi Arabia, Sudan, United Arab Emirates, Yemen, and Zimbabwe). Asia and the Pacific include ASEAN (Cambodia, Indonesia, Malaysia, Philippines, Singapore and Thailand), CER (Australia and New Zealand), SAFTA (Bangladesh, India, Maldives, Nepal, Pakistan, and Sri Lanka), and other (China, Fiji, Hong Kong, Japan, Korea, Mongolia, and Samoa). Europe includes CEFTA (Bulgaria, Czech Republic, Hungary, Poland, Romania, Slovakia, and Slovenia), CIS (Armenia, Azerbaijan, Belarus, Kazakhstan, Moldova, Russia, and Ukraine), EFTA (Iceland, Norway, and Switzerland), ELL FTA (Estonia, Latvia, and Lithuania), EU (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom), and other (Albania, Bosnia and Herzegovina, Croatia, Georgia, and Macedonia). The Western Hemisphere includes the Andean Community (Colombia, Ecuador, Peru, and Venezuela), CACM (El Salvador, Guatemala, Honduras, and Nicaragua), MERCOSUR (Argentina, Brazil, Paraguay, and Uruguay), NAFTA (Canada, Mexico, and the United States), and other (Chile, Costa Rica, Dominican Republic, Jamaica, and Panama).

TABLE 1.3 – SUMMARY STATISTICS (2006-2011)

Variables	Unit	Mean	SD	Min	Max	Countries
	(1)	(2)	(3)	(4)	(5)	(6)
All countries						
Exports (bilateral)	US$	531,443,369.40	1,062,755,205.00	0.89[a]	327,951,374,882.50	122
Aggregate exports	US$	99,903,975,012.65	211,017,210,213.50	3,448,320.23	1,659,352,994,184.00	122
Export delays	Days	20.84	12.19	6	89	122
Custom and terminal delays	Days	5.63	2.80	2	19	122
Documents and transportation delays	Days	15.21	10.26	3	70	122
Export costs	US$	1,134.92	638.92	368.59	5,051.20	122
Custom and terminal costs	US$	365.58	164.43	53.77	991.87	122
Documents and transportation costs	US$	769.35	555.27	120.03	4,067.82	122
Distance	KM	7,088.71	1,895.15	59.62	19,812.04	122
GDP	US$	446,715,245,479.60	1,414,132,905,283.43	131,150,139.24	13,846,778,428,638.92	122
GDPC	US$	12,678.67	16,406.48	153.58	88,329.48	122
Political Stability	index	-0.11	0.91	-2.81	1.50	122
Voice and Accountability	index	0.07	0.90	-1.75	1.67	122
Corruption	index	4.32	2.18	1.60	9.60	122
Developing countries						
Exports (bilateral)	US$	244,369,495.83	729,166,877.66	0.89	289,713,729,510.11	86
Aggregate exports	US$	42,898,751,861.98	142,439,412,665.70	3,448,320.23	1,659,352,994,184.00	86
Export delays	Days	24.69	12.08	8	89	86
Custom and terminal delays	Days	6.51	2.74	2	19	86
Documents and transportation delays	Days	18.17	10.48	5	70	86
Export costs	US$	1,216.44	716.64	368.59	5,051.20	86
Custom and terminal costs	US$	386.17	175.97	53.77	991.87	86
Documents and transportation costs	US$	830.27	632.93	120.03	4,067.82	86
Distance	KM	7,082.64	1880.41	85.94	19,812.04	86
GDP	US$	174,375,266,135.51	533,071,529,481.96	131,150,139.24	6,526,710,500,583.00	86
GDPC	US$	3,377.68	2,653.09	153.58	9,222.91	86
Political Stability	index	-0.45	0.80	-2.81	1.19	86
Voice and Accountability	index	-0.28	0.68	-1.75	1.23	86
Corruption	index	3.19	1.02	1.60	7.30	86
High-income countries						
Exports (bilateral)	US$	1,037,331,251.24	1,267,589,695.63	0.91	327,951,374,882.50	48
Aggregate exports	US$	197,693,581,778.30	254,047,782,537.60	2,181,544,893.51	1,346,081,240,593.00	48
Export delays	Days	14.38	11.53	6	76	48
Custom and terminal delays	Days	4.23	2.43	2	14	48
Documents and transportation delays	Days	10.15	9.42	3	62	48
Export costs	US$	1,001.43	467.07	393.16	2,790.07	48
Custom and terminal costs	US$	334.39	148.69	115.88	872.55	48
Documents and transportation costs	US$	667.04	374.81	193.74	2,388.94	48
Distance	KM	7,194.97	2003.03	59.62	19,747.40	48
GDP	US$	948,908,748,895.86	2,102,965,923,594.63	11,145,055,550.68	13,846,778,428,638.92	48
GDPC	US$	28,876.79	16,405.23	9,212.41	88,329.48	48
Political Stability	index	0.54	0.69	-1.62	1.50	48
Voice and Accountability	index	0.69	0.92	-1.70	1.67	48
Corruption	index	6.24	2.22	1.90	9.60	48

Notes: The number of trade partners varies by exporter and for some exporters data is not available for the whole period considered. To avoid unbalanced weights in the calculation of the variables' means, each variable is first averaged by exporter before computing the overall means and standard deviations reported in the table. Developing and high-income countries are defined as countries with a GDP per capita below and above $10,065 respectively. Some countries change categories between 2006 and 2011. Hence, the sum of the number of countries corresponding to high income and developing countries is not equal to the overall number of exporters reported in column 6. Monetary variables are in constant 2005 values. [a] Between 2006 and 2011 the *United Nations Comtrade Database* reports 42 export values equal to US$1.

TABLE 1.4 – NAÏVE PANEL CORRELATIONS BETWEEN EXPORT COSTS AND EXPORT DELAYS (2006-2011)

	Correlation coefficient (1)	OLS (2)	
Panel A. Dependent variable: Documents & transportation costs			
Documents & transportation delays	0.454	0.453***	(0.04)
Constant		5.310***	(0.09)
Panel B. Dependent variable: Customs & terminals costs			
Customs & terminal delays	0.372	0.350***	(0.04)
Constant		5.227***	(0.06)
Observations	697	697	

Notes: Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

TABLE 1.5 – ENDOGENOUS EXPORT COSTS (2006-2011)

	All countries		Developing countries		High-income countries	
	Time Differences	Levels	Time Differences	Levels	Time Differences	Levels
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Dependent variable: Documents & transportation costs						
Documents & transportation delays	0.130***	0.099**	0.155**a	0.095[a]	0.086[a]	0.044
	(0.05)	(0.04)	(0.08)	(0.07)	(0.09)	(0.07)
Aggregate Exports	0.165	-0.297**	0.124	-0.391**	0.451	0.906**
	(0.11)	(0.13)	(0.12)	(0.16)	(0.31)	(0.39)
Political Stability	-0.013	-0.016	-0.001	-0.014	-0.064***	-0.138***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.05)
Corruption	-0.025	-0.034	-0.106	0.022	0.502***	-0.472*
	(0.08)	(0.07)	(0.11)	(0.12)	(0.08)	(0.25)
Voice and Accountability	-0.002	0.033**	-0.007	0.031*	-0.110*	0.587**
	(0.01)	(0.02)	(0.01)	(0.02)	(0.06)	(0.25)
Overidentification test (*P-value*)	0.6490	0.4930		0.7138	0.5644	0.4723
Observations	710	952	191	313	444	535
Panel B. Dependent variable: Customs & terminals costs						
Customs & Terminals delays	-0.140***	0.004[a]	-0.351***	-0.164**	0.022 [a]	0.011
	(0.05)	(0.05)	(0.10)	(0.08)	(0.06)	(0.08)
Aggregate Exports	0.360***	0.769***	0.516***	0.406**	0.119	3.189***
	(0.13)	(0.21)	(0.19)	(0.20)	(0.24)	(0.69)
Political Stability	-0.024	0.062***	-0.088***	0.017	0.033	-0.097*
	(0.02)	(0.02)	(0.03)	(0.02)	(0.03)	(0.06)
Corruption	-0.356**	-0.178	-0.550*	-0.227	0.233*	-0.622***
	(0.18)	(0.15)	(0.29)	(0.20)	(0.12)	(0.21)
Voice and Accountability	0.084	0.012	0.087	-0.019	0.088	1.364***
	(0.06)	0.03	(0.05)	(0.03)	(0.12)	(0.25)
Overidentification test (*P-value*)	0.6149	0.4726	0.5345	0.6192		0.7333
Observations	710	952	191	313	444	535

Notes: All regressions are estimated using fixed effects in the context of an IV2SLS approach where Agg. Exports are instrumented using the ratio of exporting countries' GDP, GDP per capita, and aggregate distance to all respective trade partners. Reported statistics are robust to the presence of arbitrary heteroskedasticity. The panel used in all regressions is balanced.

[a] In these formulations the estimated covariance matrix of moment conditions is not of full rank. This issue does not affect the estimated coefficients or the standard errors, but it does not allow an estimation of the Overidentification test. The problem is addressed by partialling out Political Stability, Corruption and Voice and Accountability. However, in two of the formulations (Panel A column 3 and Panel B column 5) this approach does not successfully address the issue and, consequently, the Overidentification test is not reported.

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

TABLE 1.6 – EFFECT OF EXPORT TIME DELAYS AND PECUNIARY EXPORT COSTS ON EXPORT VOLUMES – A CROSS-COUNTRY PERSPECTIVE (2009)

Dependent Variable: Ratio of Exports from Similar Country Pairs to the Same Market

	All countries		Developing countries		High income countries	
	(1)	(2)	(3)	(4)	(5)	(6)
Exp. Delays	-0.633***	-0.565***	-1.628**	-0.654	-0.320*	-0.269
	(0.22)	(0.21)	(0.67)	(0.88)	(0.18)	(0.20)
Exp. Costs		-0.275		-1.640**		-0.141
		(0.20)		(0.82)		(0.22)
Distance	-1.287***	-1.306***	-1.778***	-1.854***	-1.186***	-1.188***
	(0.09)	(0.09)	(0.26)	(0.28)	(0.06)	(0.06)
GDP	1.096***	1.116***	0.962***	1.103***	1.119***	1.135***
	(0.04)	(0.04)	(0.09)	(0.14)	(0.05)	(0.06)
GDPC	0.485***	0.479***	0.832***	0.741***	0.675***	0.738***
	(0.18)	(0.17)	(0.17)	(0.16)	(0.25)	(0.27)
Contiguity	0.121	0.095	0.523**	0.573***	-0.165*	-0.178**
	(0.10)	(0.10)	(0.21)	(0.21)	(0.09)	(0.09)
Colony	0.820***	0.807***	0.526***	0.581***	0.712***	0.700***
	(0.11)	(0.11)	(0.19)	(0.17)	(0.10)	(0.10)
Language	0.568***	0.624***	0.294	0.378	0.770***	0.805***
	(0.11)	(0.10)	(0.27)	(0.23)	(0.10)	(0.08)
Landlocked	-0.141	-0.092	0.263	0.819	-0.073	-0.037
	(0.13)	(0.13)	(0.50)	(0.50)	(0.15)	(0.16)
Constant	0.073	0.090	0.073	0.110	0.019	0.022
	(0.07)	(0.07)	(0.17)	(0.16)	(0.08)	(0.08)
Observations	21,429	21,429	4,306	4,306	15,323	15,323
R^2	0.490	0.491	0.473	0.485	0.562	0.562
Overidentification test (*P-value*)	0.1284	0.1682	0.1265	0.1693	0.0000	0.0000

Notes: All regressions cluster observations by pairs of exporters, and all reported standard errors are robust to the presence of arbitrary heteroskedasticity. In addition, export delays and export costs are instrumented with their first lags as well as the number of custom inspections of imports and our indexes of corruption, political stability, and voice and accountability. Developing and high-income countries are defined as countries with a GDP per capita below and above $10,065 respectively. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

TABLE 1.7 – VALUE OF A STANDARDIZED KILOGRAM OF CONTAINERIZED EXPORTS

	Countries in sample	Average value (US$)
Developing	88	14.48
High Income	33	27.30

Notes: Data from the U.S. Department of Commerce

TABLE 1.8 – POOLED EFFECT OF EXPORT TIME DELAYS AND PECUNIARY EXPORT COSTS ON EXPORT VOLUMES (2006 – 2011)

Dependent Variable: Ratio of Exports from Similar Country Pairs to the Same Market

	All countries		Developing countries		High income countries	
	(1)	(2)	(3)	(4)	(5)	(6)
Exp. Delays	-0.639***	-0.633***	-1.435**	-0.379	-0.388**	-0.431**
	(0.17)	(0.18)	(0.60)	(0.84)	(0.18)	(0.20)
Exp. Costs		-0.0291		-2.039**		0.115
		(0.18)		(0.88)		(0.22)
Distance	-1.312***	-1.314***	-1.769***	-1.952***	-1.174***	-1.172***
	(0.08)	(0.08)	(0.26)	(0.30)	(0.05)	(0.05)
GDP	1.085***	1.088***	0.909***	1.023***	1.119***	1.105***
	(0.04)	(0.04)	(0.12)	(0.15)	(0.05)	(0.05)
GDPC	0.388***	0.386***	0.762***	0.789***	0.678***	0.643***
	(0.14)	(0.14)	(0.18)	(0.17)	(0.23)	(0.24)
Contiguity	0.159*	0.156*	0.837***	0.823***	-0.083	-0.071
	(0.09)	(0.09)	(0.22)	(0.21)	(0.08)	(0.08)
Colony	0.720***	0.719***	0.608***	0.560***	0.647***	0.658***
	(0.10)	(0.10)	(0.17)	(0.17)	(0.10)	(0.09)
Language	0.527***	0.533***	0.120	0.242	0.727***	0.697***
	(0.11)	(0.10)	(0.27)	(0.23)	(0.11)	(0.08)
Landlocked	-0.176	-0.170	-0.142	0.712	-0.107	-0.139
	(0.12)	(0.12)	(0.40)	(0.46)	(0.15)	(0.16)
Constant	0.064	0.066	-0.090	0.111	0.042	0.039
	(0.07)	(0.07)	(0.21)	(0.17)	(0.07)	(0.07)
Observations	88,966	88,966	14,192	14,192	65,361	65,361
R^2	0.485	0.486	0.415	0.434	0.552	0.552
Overidentification test (P-value)	0.3188	0.3164	0.2017	0.3478	0.0000	0.0000

Notes: All regressions cluster observations by pairs of exporters, and all reported standard errors are robust to the presence of arbitrary heteroskedasticity. In addition, export delays and export costs are instrumented with their second lags as well as the number of custom inspections of imports and our indexes of corruption, political stability, and voice and accountability. Developing and high income countries are defined as countries with a GDP per capita below and above $10,065, respectively. In the interest of brevity, time dummy variables are not reported. The panel used is unbalanced. Standard errors in parentheses *** p<0.01, **p<0.05, * p<0.1

TABLE 1.9 –EFFECT OF EXPORT TIME DELAYS AND PECUNIARY EXPORT COSTS ON EXPORT VOLUMES - OLS

Dependent Variable: Ratio of Exports from Similar Country Pairs to the Same Market				
	Developing countries		High-income countries	
	Cross-sectional 2009	Pooled 2006-2011	Cross-sectional 2009	Pooled 2006-2011
	(3)	(4)	(5)	(6)
Exp. Delays	0.389*	0.103	-0.492**	-0.596***
	(0.23)	(0.21)	(0.20)	(0.20)
Exp. Costs	-1.270***	-0.939***	-0.389*	-0.093
	(0.28)	(0.24)	(0.21)	(0.18)
Distance	-1.468***	-1.400***	-1.091***	-1.161***
	(0.15)	(0.13)	(0.06)	(0.05)
GDP	1.318***	1.266***	1.216***	1.177***
	(0.05)	(0.05)	(0.05)	(0.05)
GDPC	0.136*	0.042	0.995***	0.697***
	(0.08)	(0.08)	(0.25)	(0.23)
Contiguity	0.847***	1.200***	0.008	0.025
	(0.15)	(0.13)	(0.09)	(0.09)
Colony	-0.003	-0.094	0.661***	0.635***
	(0.18)	(0.15)	(0.08)	(0.08)
Language	0.492***	0.557***	0.881***	0.714***
	(0.14)	(0.13)	(0.07)	(0.09)
Landlocked	-0.368*	-0.482**	0.087	-0.003
	(0.21)	(0.20)	(0.14)	(0.15)
Constant	-0.132	-0.045	0.012	0.093
	(0.09)	(0.11)	(0.07)	(0.08)
Observations	16,419	95,250	20,339	122,681
R^2	0.465	0.420	0.571	0.561

Notes: All regressions cluster observations by pairs of exporters, and all reported standard errors are robust to the presence of arbitrary heteroskedasticity. Developing and high-income countries are defined as countries with a GDP per capita below and above $10,065 respectively. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

TABLE 1.10 – EFFECT OF EXPORT TIME DELAYS AND PECUNIARY EXPORT COSTS ON THE EXPORT VOLUMES OF DEVELOPING COUNTRIES– DISAGGREGATED CATEGORIES (2006 – 2011)

Dependent Variable: Ratio of Exports from Similar Country Pairs to the Same Market

	Pooled – 2SLS		Fixed effects – 2SLS	
	(1)	(2)	(3)	(4)
Custom and terminal delays	-0.793***	-0.361	-0.683	-0.625
	(0.28)	(0.55)	(0.54)	(0.44)
Documents and transportation delays	-0.562	0.0477	-2.043*	0.626
	(0.56)	(0.58)	(1.14)	(1.25)
Custom and terminal costs		-1.474***		-1.670**
		(0.45)		(0.84)
Documents and transportation costs		-0.218		-0.131
		(0.71)		(0.32)
Distance	-1.886***	-1.735***		
	(0.28)	(0.29)		
GDP	0.909***	1.098***	-1.859	-0.131
	(0.11)	(0.14)	(4.42)	(4.51)
GDPC	0.791***	0.399**	1.758	0.675
	(0.17)	(0.17)	(4.40)	(4.45)
Contiguity	0.791***	0.867***		
	(0.22)	(0.23)		
Colony	0.602***	0.693***		
	(0.17)	(0.17)		
Language	0.167	0.297*		
	(0.24)	(0.17)		
Landlocked	-0.354	-0.836		
	(0.39)	(0.69)		
Constant	-0.123	0.101		
	(0.20)	(0.18)		
Observations	14,192	14,192	11,578	11,578
R^2	0.424	0.442		
Number of panels			3,533	3,533
Overidentification (P-value)	0.1902	0.0113	0.1562	0.4547

Notes: All regressions cluster observations by pairs of exporters, and all reported standard errors are robust to the presence of arbitrary heteroskedasticity. In addition, export delays and export costs are instrumented with their second lags as well as the number of custom inspections of imports and our indexes of corruption, political stability, and voice and accountability. Developing countries are defined as countries with a GDP per capita below $10,065. In the interest of brevity, time dummy variables are not reported. The panel is unbalanced. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

1.7. **Appendix for Chapter 1**

"The initial costs for implementing most trade facilitation measures would likely be moderate in relation to potential gains from lower transaction costs. Some of the initial costs may be transferred to traders through charges for relevant services they receive. Some trade facilitation measures, such as collateral security for release of goods are in themselves financial services offered by the private sector

Costs of implementation vary substantially across trade facilitation measures. For instance, measures that entail modernisation of information technology are more costly than the periodic review of import/ export documentation; and

The costs of certain measures are likely to vary according to individual situation of member countries." (UNECA 2013, p. 42)

"The government created a private company to manage TradeNet, which in 1988 led to the formation of Singapore Network Services, now known as Crim-sonLogic. Though funded by government agencies, the company is structured as a private, for-profit firm. The government reasoned that this approach would not require it to bear the cost of operating a nationwide network of infrastructure and services. Each account user pays $20 a month and less than $3 per transaction or permit. The first transaction on TradeNet was a shipping application submitted on January 1, 1989. By the end of that year TradeNet handled 45% of documentation for sea and air shipments in Singapore." (World Bank 2014, p. 61)

"Some developing countries may view costs associated with implementing trade facilitation measures as prohibitive, but evidence

suggests otherwise. The introduction and implementation of trade facilitation measures do entail startup costs for government agencies; however, these reforms eventually reduce government expenditures by enhancing transaction efficiency and transparency, eliminating duplicative functions, and allowing a more economical and efficient use of administrative resources. In practice, some of the initial costs are also transferred to traders through charges for services provided." (ADB 2013, p. 9)

"The process of the implementation of Trade Facilitation will certainly produce some costs. These costs will be caused by reducing TTCs, because this will require higher operational expenses and investments. Firstly, all modernizations and reforms will start from customs services, but it will not be the only investment. Other government services in correlation with border procedures also have to be improved. The volume of investments depends on the general economic environment presented by the existing level of infrastructure, the size of government services and the educative level of human resources. This is not a inexpensive investment, but once the country improves functioning border procedures, that system has to be updated from time to time and expenses are transferred to traders in one group of countries and financed from government budgets in other countries." (Bjelic and Popovic Petovic 2009, p. 11)

"To a large extent, establishing an advance binding ruling regime is a re-orientation of certain customs administrative decision-making away from the border, and into a function that may not be attached to an actual ongoing trade transaction. As such, it can involve redirection of administrative resources, but involves costs associated with training personnel, some of which may be transitional. A possible method for an

advance ruling regime to be self-supporting would be through a reasonable fee structure for obtaining a ruling, which some Members already use. Another possibility for reducing the costs in establishing a regime would be through resource sharing, such as through a regional ruling authority. In its recent survey, the OECD reported that countries it reviewed did not consider the administration of binding rulings as calling for additional resources."(WTO 2005a, p. 2)

"The cost of setting up an express clearance system mainly hinges upon the degree of business demand and the existing customs facilities. In our case, we established 20 new processing lines, each equipped with an X-ray scanning machine. There are a total of 117 officers at the Express Division, working day and night shifts so as to provide a 24/7 service. These officers were relocated from other divisions. Basically, there was no need for major new personnel recruitment overall. Customs may consider cooperating with existing express service providers to share some of the initial infrastructure costs. Some operational costs may also be borne by express shipment providers." (WTO 200b, p. 3)

Declaration for Thesis Chapter 2

Declaration by candidate

In the case of Chapter 2, the nature and extent of my contribution to the work was the following:

Nature of contribution	**Extent of contribution (%)**
Construction of the basic conceptual framework, analytical design and write up	50%

The following co-authors contributed to the work. If co-authors are students at Monash University, the extent of their contribution in percentage terms must be stated:

Name	**Nature of contribution**	**Extent of contribution (%) for student co-authors only**
Christis Tombazos	Construction of the basic conceptual framework, analytical design and write up	
Horag Choi	Construction of the basic conceptual framework, analytical design and write up	

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the candidate's and co-authors' contributions to this work*.

Candidate's Signature	[redacted]	**Date** **27/02/2015**

Main Supervisor' Signature	[redacted]	**Date** **27/02/2015**

*Note: Where the responsible author is not the candidate's main supervisor, the main supervisor should consult with the responsible author to agree on the respective contributions of the authors.

Chapter 2: Government Choice to Fund Export Delays Reduction

2.1. Introduction

Anecdotal information in the form of countries' self-declarations produced in the scope of multilateral trade facilitation negotiations suggest that the implementation of policies to reduce export delays is costly, and that the generated costs are transferred to exporters. In Chapter 1 we provide statistical evidence in support of this idea. Our results indicate that government efforts to reduce export delays are, at least in developing countries, financed by increments in export fees. However, it is unclear why governments would choose this course of action instead of taxing the general population, in particular considering that the increment in monetary costs to export may actually neutralise or even revert the benefits of reducing export delays.

In this chapter we propose one theoretical model which provides a plausible explanation. In our model the government chooses to finance reductions in export delays by increasing monetary costs to export because this strategy maximises social welfare. We show that, by passing the cost to exporting firms, governments create market incentives that maximises economic efficiency.

2.2. A Social Welfare Explanation

In this section we develop a version of the Melitz (2003) model for the case of a small open economy with pecuniary export costs and export delays to investigate the relationship between these trade frictions, and the effects of them on trades.[28] The small open economy is populated by a unit mass of

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[28] Demidova and Rodríguez-Clare (2009, 2013) also use small open economy versions of the Melitz (2003) models for the analyses of the optimal tariffs.

identical households who inelastically supply labor which is normalized to 1, $L = 1$. The preferences of the economy are based on a continuum of home goods and a foreign good with the Dixit-Stiglitz preferences with the elasticity of substitution $\theta > 1$. In the economy, there are a continuum of monopolistically competitive firms characterized by their productivity z. The productivity of firms z follows a Pareto distribution with the cumulative distribution function of $G(z) = 1 - z^{\beta}$ with $z > 1$ and $\beta > \theta - 1$.[29] The total number of producers in the economy is normalized to 1. Exporting is costly. Each exporter faces iceberg trade costs $\tau \geq 1$ for shipping its goods abroad. In addition to the shipping cost, there are marginal exporting costs due to the time consuming exporting process. The cost of delay in exporting at home is given by an iceberg cost of $\delta > 1$. Similarly, the cost of delay in the destination is given by $\delta^* > 1$. Thus, the overall marginal trade cost is given by $\xi = \tau\delta\delta^*$.[30] Besides these marginal costs, if a firm in the country sells its goods abroad, it has to pay a fixed pecuniary cost f_p to the government. A firm exports its goods if the profits from exporting can cover the pecuniary cost. The government collects the pecuniary costs f_p from home exporters, and lump-sum taxes T from home households to finance the operating costs for the export process. The government chooses f_p to maximize the real income of the country.[31] All prices are in international dollars. We now

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[29] We normalize the minimum level of productivity to 1, $inf\ (z) = 1$, as it does not affect the results.

[30] These marginal costs are "iceberg" so ξ units should be shipped for one unit to arrive.

[31] We assume that the government of the country chooses f_p given δ. The pecuniary cost f_p is imposed to home exporters but not to foreign exporters. Thus, f_p does not affect the foreign exporters directly. However, the cost of delay in exporting, δ directly affects both home and foreign exporters. Thus

present the model setup and key equations for the analysis. The detailed derivations of the key equations are presented in the Appendix.

Preferences

The preferences over goods are given by

$$Y = \left[\int y_h(z)^{\frac{\theta-1}{\theta}} dG(z) + y_f^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}, \tag{1}$$

where $y_h(z)$ is the good produced by a home firm with its productivity z, and y_f is the imported good. The first order conditions to maximize Y given prices of goods and the expenditure give the demand for goods as

$$y_h(z) = [p_h(z)]^{-\theta} P^{\theta} Y, \tag{2}$$

$$y_f = p_f^{-\theta} P^{\theta} Y, \tag{3}$$

where $p_h(z)$ is the price of good produced by a home firm with z; p_f is the price of imported good; and P is the price index defined as

$$P = \left[\int p_h(z)^{1-\theta}\, dG(z) + p_f^{1-\theta}\right]^{\frac{1}{1-\theta}}. \tag{4}$$

Analogously, the demand for home goods in the foreign country, $y_h^*(z)$, is given by

$$y_h^*(z) = [p_h^*(z)]^{-\theta} P^{*\theta} Y^*, \tag{5}$$

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the government freely chooses f_p to maximize its objective function, whereas it goes through a negotiation with foreign countries to coordinate δ and δ^*.

where $p_h^*(z)$ is the price of good produced by a home firm with z in the foreign country, and an asterisk $(*)$ denotes the foreign equivalent. Since the home country is a small open economy, we assume that the home economy cannot affect the foreign variables, P^* and Y^*. For notational convenience, let D denote the constant foreign aggregate factor in the foreign demand, $D = P^{*\theta} Y^*$.

Firms: The production technology of a firm is given by

$$y(z) = zl(z), \tag{6}$$

where $y(z)$ is the output, and $l(z)$ is the labour input in production for a firm with its productivity z. If a firm wants to export goods abroad, it has to pay for the fixed pecuniary cost f_p to the government. Let m be the exporting status of a producer where $m = 1$ for an exporter and $m = 0$ for a non-exporter. The marginal trade cost that an exporter faces is $\xi = \tau\delta\delta^*$. Excluding the fixed pecuniary cost, f_p, a firm with z maximizes its operating profit

$$\max \pi\,(z) = p_h(z)\, y_h(z) + m p_h^*(z) y_h^*\,(z) - wl(z), \tag{7}$$

where w is the wage rate. By choosing $p_h(z)$, $p_h^*(z)$, $l(z)$, and m subject to the demands for goods at home and foreign, (2) and (5), the production technology, (6), and the resource constraint

$$y(\mathrm{z}) = y_h(z) + m\xi y_h^*(z), \tag{8}$$

The first order conditions of the profit maximization problem give the prices for two markets,

$$p_h(z) = \left(\frac{\theta}{\theta-1}\right)\frac{w}{z}, \tag{9}$$

$$p_h^*(z) = \left(\frac{\theta}{\theta-1}\right)\frac{\xi w}{z}. \tag{10}$$

A firm exports its goods if the operating profit from exporting can cover the fixed pecuniary cost. The exporting cutoff technology, z_x, satisfies

$$f_p = \left(\frac{1}{\theta}\right)\left(\frac{\theta w}{\theta-1}\right)^{1-\theta}\xi^{1-\theta}D{n_x}^{-\frac{1}{\eta}}, \tag{11}$$

where n_x is the export ratio, $n_x = \int_{z_x}^{\infty} dG(x) = {z_x}^{-\eta(\theta-1)}$ with $\eta = \beta/(\theta-1) > 1$.[32] A firm with $z < z_x$ will not engage in the foreign market whereas a firm with $z \geq z_x$ will export its goods abroad. As shown in the Appendix , the total labour input in production, L_p, can be written as

$$L_p = \int l(z)dG(z) = \left(\frac{\theta w}{\theta-1}\right)^{-\theta}\left(P^{\theta}Y\Psi_d + \xi^{1-\theta}D\Psi_x\right), \tag{12}$$

where,

$\Psi_d = \int_1^{\infty} z^{\theta-1}\,dG(z) = \frac{\eta}{\eta-1}$, and $\Psi_x = \int_{z_x}^{\infty} z^{\theta-1}\,dG(z) = \left(\frac{\eta}{\eta-1}\right)n_x^{(\eta-1)/\eta}$, are the elasticity adjusted aggregate productivity of all home producers and exporters, respectively.

From the demand for goods at foreign and its price, (5) and (10), the total export of home is given by

$$EX = \int_{z_x}^{\infty} p_h^*(z)y_h^*(z)dG(z) = \left(\frac{\theta w}{\theta-1}\right)^{1-\theta}\xi^{1-\theta}D\Psi_x. \tag{13}$$

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[32] See the Appendix for the derivations.

Similar to the price of home goods in the foreign, we assume that the price of imported good is given by

$$p_f = \xi p_f^*, \tag{14}$$

where p_f^* is the price of the foreign goods in the foreign country. The total import from the demand for imported goods and its price at home, (3) and (14), is given by

$$IM = p_f y_f = \xi^{1-\theta} p_f^{*1-\theta} P^{\theta} Y. \tag{15}$$

Government and Export Operation Cost

The government collects exporting fees, pecuniary costs f_p, from home exporters, and lump-sum taxes T from home households. The revenue is used for hiring labour, H, to operate the customs office given exporting delay, δ. The government budget constraint is given by

$$wH = n_x f_p + T. \tag{16}$$

The required labour input for the export operation, H, depends on the total exports, EX, and the export delay, δ. Specifically, the required labour, H, is given by

$$H = \gamma^{-1} EX^{\alpha} \delta^{-\mu}, \tag{17}$$

where $\gamma > 0$ measures the efficiency of the government in operating the export process;[33] $\alpha > 2$ so that the labour requirement, H, is increasing and convex with respect to exports, EX; and $\mu > \alpha$ so that H is decreasing and convex with respect to export delay, δ, and is decreasing in δ given EX/δ, exports net of delay costs.[34] The government chooses f_p (equivalently T) to maximize the income of the country, Y.

Closing the Model

The model is closed with the balanced trade condition,

$$EX = IM, \tag{18}$$

and the labour market clearing condition,

$$L = L_p + H, \tag{19}$$

where L is the total labour supply at home normalized to $L = 1$.[35]

Results

Here, we present the solution and the main implications from the model.[36] For notational convenience, we denote $\hat{x} = dln\ x$ for any variable x:

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[33] We assume that γ is not too high so that it is always optimal for the government to discourage unproductive firms from exporting.

[34] We can have $EX + IM$ instead of EX in (17). But, with the balanced trades, the results will be the same.

[35] Alternatively, we can close the model with the household's budget constraint which is equivalent to the labour market clearing condition.

[36] The derivations of the equations for the results are in the Appendix.

Optimal f_p

The government chooses f_p to maximize the output of the country, Y. Let's define the terms-of-trade as the export to import price ratio,

$$TOT = \frac{P_X}{p_f} = \left(\frac{\theta}{\theta-1}\right) \Psi_x{}^{-\left(\frac{1}{\theta-1}\right)} \left(\frac{w}{p_f^*}\right), \tag{20}$$

where P_X is the export price index, $P_X = \left\{\int [p_h^*(z)]^{1-\theta} dG(z)\right\}^{\frac{1}{1-\theta}}$. From the price index (4), price of a home goods at home and foreign markets, (9) and (10), the total labour input in production (12), the balanced trade condition (18) together with the total export and import, (13) and (15), and the terms-of-trade, (20), we have the output of the country as

$$Y = \left[\left(\frac{\eta}{\eta-1}\right) + \xi^{1-\theta}\Psi_x TOT^{\theta-1}\right]^{\frac{1}{\theta-1}} L_p. \tag{21}$$

A change in f_p affects Y through three channels: (i) the effective productivity gain from trades, $\xi^{1-\theta}\Psi_x$; (ii) the terms-of-trade, TOT; and (iii) the resource allocation for production, L_p. From the system of equations that governs the equilibrium of the economy, we can find these three channels. First, the effective productivity gain from trades, $\xi^{1-\theta}\Psi_x$, is decreasing in f_p,

$$\frac{\partial \ln \xi^{1-\theta}\Psi_x}{\partial \ln f_p} = -\frac{(\eta-1)\left\{[(\theta-1)(1+\lambda)+1]L_p + \alpha(\theta-1)H\right\}}{[(\eta+\lambda)(\theta-1)+1]L_p + \alpha\eta(\theta-1)H} < 0. \tag{22}$$

An increase in f_p discourages relatively less productive firms from exporting. So the cut off productivity z_x, rises. This results in a reduction of the number of exporters, n_x , and the aggregate (elasticity adjusted) productivity of exporters, Ψ_x. With a fall in the effective productivity gains from trades, the output falls with a rise in f_p.

Second, we have

$$\frac{\partial \ln TOT}{\partial \ln f_p} = \left(\frac{\eta - 1}{\theta - 1}\right) \frac{[(\theta - 1)\lambda + 1]L_p}{[(\eta + \lambda)(\theta - 1) + 1]L_p + \alpha\eta(\theta - 1)H} > 0. \tag{23}$$

That is, the terms-of-trade is strictly increasing in f_p. An increase in f_p reduces both Ψ_x and w in (20). As a rise in f_p discourages less productive previous exporters from exporting, the export price index, P_X, rises with a fall in Ψ_x. The wage rate, w, can be interpreted as the marginal cost of production excluding the productivity of an exporter. A rise in f_p reduces the marginal cost of production for each exporter resulting in a fall in the terms-of-trade. [37] Thus, the former effect raises TOT whereas the latter effect lowers TOT. From (23), we can observe that the former effect dominates the latter effect, resulting in a rise in TOT with an increase in f_p. This terms-of-trade effect raises output with a rise in f_p. The last effect is the resource reallocation effect. We have

$$\frac{\partial \ln L_p}{\partial \ln f_p} = \frac{\alpha(\eta - 1)[(\theta - 1)\lambda + 1]H}{[(\eta + \lambda)(\theta - 1) + 1]L_p + \alpha\eta(\theta - 1)H} > 0. \tag{24}$$

With an increase in f_p, relatively less productive exporters stop exporting. This reduces exports and the required labour input for the export operation, $H = L - L_p$. Thus, more resources are reallocated to production. This effect raises output of the country.

The government chooses f_p with which these marginal effects cancel out each other. The overall effect of f_p on Y is given by

[37] See the Appendix for the marginal effect of f_p on w.

$$\frac{\partial \ln Y}{\partial \ln f_p} = \frac{B_f}{B_y}, \tag{25}$$

where

$$B_f = (\eta - 1)\left[\alpha\theta\lambda H - (1-\lambda)L_p\right], \tag{26}$$

$$B_Y = [\eta(\theta - 1) + (\theta - 1)\lambda + 1]L_p + \alpha\eta(\theta - 1)H > 0. \tag{27}$$

Here, $\lambda = \left(\frac{\theta w}{\theta - 1}\right)^{1-\theta} \Psi_d P^{\theta - 1}$.[38] Thus, the government chooses $f_p = f_p^*$ so that $B_f = 0$.[39] With $f_p = f_p^*$, the equilibrium L_p and H are given by

$$L_p = \frac{\alpha\theta\lambda}{\alpha\theta\lambda + 1 - \lambda}, \tag{28}$$

$$H = \frac{1 - \lambda}{\alpha\theta\lambda + 1 - \lambda}. \tag{29}$$

A Delay Reduction

Using the first order conditions and the condition for the optimal f_p, $B_f = 0$, we have

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[38] For the existence of an inner solution which requires $\alpha\lambda > 1$, we assume that the export to GDP ratio, $1 - \lambda$, is less than 1/2.

[39] We can check that the second order condition of the maximization problem is also satisfied.

$$\frac{\partial \ln f_p^*}{\partial \ln \delta} = -\left(\frac{1}{\eta - 1}\right)\left\{2\eta(\theta - 1) + 1 + \left[1 + \frac{\alpha\theta\lambda[\eta(\theta - 1) + \theta\lambda]}{(1 - \lambda)\phi}\right]\frac{(\mu - \alpha)H}{1 + (\alpha - 1)H}\right\}, \quad (30)$$

where $\phi = [1 + (1 - \lambda) + \theta(\alpha\lambda - 1)]L_p > 0$. Clearly, a reduction of delay comes with a rise in the pecuniary cost, $\partial \, ln \, f_p^* / \partial \, ln \, \delta < 0$. Intuitively, when there is a cut in delay, δ, the operating cost of exporting H rises directly from (17). It also raises the number of exporters, since more firms find it profitable to export with a fall in the effective marginal trade cost ξ. By raising f_p with a cut in delay, the government can improve the terms-of-trade, and prevent inefficient firms (relative to the additional operating costs due to the additional exporters) from exporting to maximize Y.

Efficiency Improvements

Efficiency of the government in handling export operation is captured by γ. We have

$$\frac{\partial \ln f_p^*}{\partial \ln \gamma} = -\left(\frac{1}{\eta - 1}\right)\left\{1 + \frac{\alpha\theta\lambda[\eta(\theta - 1) + \theta\lambda]}{(1 - \lambda)\phi}\right\}\frac{\mu H}{1 + (\alpha - 1)H}. \quad (31)$$

An improvement of efficiency reduces the pecuniary cost, f_p^*, $\partial \, ln \, f_p^* / \partial \, ln \, \gamma < 0$. Clearly, a rise in γ reduces the overall cost of operation in export handling, H. Thus the government has an incentive to reduce the fee to the exporters, f_p, to promote exporting business and to increase the income of the economy.

Responses of Exports

We can rewrite the change in the exports as

$$\widehat{EX} = \frac{1}{\eta(\theta-1)+\theta\lambda}[\eta(\theta-1)\hat{Y} - (\eta-1)\theta\lambda\widehat{f_p} - \eta(\theta-1)(2\theta\lambda - 1)\hat{\delta}]. \tag{32}$$

Exports are increasing in the income of the country, but decreasing in the pecuniary cost, f_p, and exporting delay, δ.

A Delay Reduction

When f_p is chosen optimally, $f_p = f_p^*$, we have

$$\left.\frac{\partial \ln EX}{\partial \ln \delta}\right|_{f_p=f_p^*} = 1 + \left[1 + \frac{\alpha\theta^2\lambda^2}{(1-\lambda)\phi}\right]\frac{(\mu-\alpha)H}{1+(\alpha-1)H} > 0. \tag{33}$$

A reduction of delay, $\hat{\delta} < 0$, reduces exports. Although a cut in delay raises exports directly because of a fall in the marginal cost of exports for exporters, the cut comes with a rise in f_p^* due to an increased cost of operation. A rise in f_p makes fewer firms be profitable to export. Thus, exports falls due to a reduction in the number of exporters. This indirect effect, the effect of a rise in f_p, outweighs the direct effect on exports, producing a fall in EX when there is a reduction of export delays.

An Efficiency Improvement

With the optimal choice of $f_p = f_p^*$, we have

$$\left.\frac{\partial \ln EX}{\partial \ln \gamma}\right|_{f_p=f_p^*} = \left[1 + \frac{\alpha\theta^2\lambda^2}{(1-\lambda)\phi}\right]\frac{H}{1+(\alpha-1)H} > 0. \tag{34}$$

An improvement of efficiency in export operation raises exports since the government can charge lower f_p which makes more firms find it profitable to export.

Delay Reduction Coordination

Even though exporting delay δ affects the marginal trade costs of both home and foreign firms, delay in exporting works like a tariff game for the economy. Given foreign delay, δ^*, an increase in δ is real income improving, whereas an increase in δ^* given δ is home real income deteriorating when the government always chooses f_p optimally, $f_p = f_p^*$. Let's now take $\widehat{\delta^*} \neq 0$ to find out how foreign delay affects the home economy. With optimal f_p, we have

$$\hat{Y}\Big|_{f_p=f_p^*} = \frac{H}{1+(\alpha-1)H}\left[(\mu-\alpha)\hat{\delta}+\hat{\gamma}-\alpha\widehat{\delta^*}\right]. \tag{35}$$

A cut in home delay alone reduces home income, $\partial \ln Y / \partial \ln \delta > 0$, whereas a cut in foreign delay raises home income, $\partial \ln Y / \partial \ln \delta^* < 0$. If $\alpha > \mu/2$, coordinated cuts in delay both at home and foreign, $\hat{\delta} = \widehat{\delta^*} < 0$, improve the income of the country.

2.3. **Conclusion**

In this chapter we explore one possible explanation to why governments may choose to finance reductions in export delays by increasing monetary costs to exporters instead of increasing taxes to the general public. In our theoretical model we consider the case of a government that is a welfare maximiser. We show that, by pursuing this objective, governments will choose to pass the costs of delays reductions to exporting firms because it generates market incentives that maximise national output. In addition, and in line with our findings in Chapter 1, we provide a possible explanation to why reducing export delays by increasing pecuniary export costs that are passed on to exporters may result in a negative net effect on trade. Reducing delays has two effects on trade, first, a direct positive effect by reducing the marginal cost to export and second, a negative indirect effect by increasing the exporting operating costs. In our model we show a scenario in which the negative effect of increasing pecuniary costs outweighs the direct positive effect of reducing delays, a possibility that also emerges from our empirical results in Chapter 1.

2.4. **Appendix for Chapter 2**

Model Solutions

In this appendix, we present the model solutions and derivations of the key equations for the results.

Preferences

The preferences over goods are given by

$$Y = \left[\int y_h(z)^{\frac{\theta-1}{\theta}} dG(z) + y_f^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}. \tag{A.1}$$

The demands for goods and the price index can be found from the following maximization problem:

$$\max Y = \left[\int y_h(z)^{\frac{\theta-1}{\theta}} dG(z) + y_f^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}},$$

subject to the budget constraint,

$$\int p_h(z) y_h(z) dG(z) + p_f y_f = E, \tag{A.2}$$

where E is the expenditure on goods. The first order condition gives

$$y_h(z) = [q p_h(z)]^{-\theta} Y, \tag{A.3}$$

$$y_f = \left(q p_f\right)^{-\theta} Y, \tag{A.4}$$

where q is the Lagrangian multiplier. From the preferences (A1), and the demands for goods (A3) and (A4), we have

$$Y^{\frac{\theta-1}{\theta}} = \int y_h(z)^{\frac{\theta-1}{\theta}} dG(z) + y_f^{\frac{\theta-1}{\theta}}$$
$$= Y^{\frac{\theta-1}{\theta}} q^{1-\theta} \left[\int p_h(z)^{1-\theta} dG(z) + p_f^{\,1-\theta} \right]. \tag{A.5}$$

Thus, we have

$$q = \left[\int p_h(z)^{1-\theta}\, dG(z) + p_f^{1-\theta} \right]^{\frac{1}{\theta-1}} \tag{A.6}$$

Let P be the price index so that $PY = E$. From the budget constraint (A2) and the demands for goods (A3) and (A4), we have

$$PY = Yq^{-\theta} \left[\int p_h(z)^{1-\theta} dG(z) + p_f^{\,1-\theta} \right] = Yq^{-1}. \tag{A.7}$$

Thus, we have the price index as

$$P = \left[\int p_h(z)^{1-\theta}\, dG(z) + p_f^{1-\theta} \right]^{\frac{1}{1-\theta}} \tag{A.8}$$

Finally, we can rewrite the demands for goods (A3) and (A4) as

$$y_h(z) = [p_h(z)]^{-\theta} P^{\theta} Y, \tag{A.9}$$

$$y_f = p_f^{\,-\theta} P^{\theta} Y. \tag{A.10}$$

Firms

The production technology of a firm with z given by

$$y(z) = zl(z) \tag{A.11}$$

where $y(z)$ is the output, and $l(z)$ is the labour input in production for a firm with its productivity z. Let m be the exporting status of a producer where $m = 1$ for an exporter and $m = 0$ for a non-exporter. Excluding the fixed pecuniary cost, a firm with z maximizes its operating profit

$$\max \pi\,(z) = p_h(z)\, y_h(z) + mp_h^*(z)y_h^*\,(z) - wl(z) \tag{A.12}$$

where w is the wage rate. With the linear production function (A11), we can divide the overall profit maximization problem into two profit maximization problems at home and foreign markets, $\pi_h(z)$ and $\pi_h^*(z)$, respectively. The profit maximization of the home market is given by

$$\max \pi_h(z) = p_h(z)\, y_h(z) - wl_h(z) \tag{A.13}$$

where $l_h(z)$ is the labour input used for producing goods that are sold at home. With the production function (A11) and the demand for goods at home (A9), the first order conditions gives the constant markup price at home as

$$p_h(z) = \left(\frac{\theta}{\theta - 1}\right)\frac{w}{z}\,. \tag{A.14}$$

From the demand for goods at home (A9), the production function (A11) and the price of good at home (A14), we have the labour inputs $l_h(z)$ as

$$l_h(z) = \left(\frac{\theta}{\theta - 1}\right)^{-\theta} z^{\theta-1} P^{\theta} Y, \tag{A.15}$$

and the maximized profit as

$$\pi_h(z) = \left(\frac{1}{\theta}\right)\left(\frac{\theta w}{\theta - 1}\right)^{1-\theta} z^{\theta-1} P^{\theta} Y\,. \tag{A.16}$$

Similarly, the profit maximization of the foreign market, if the firm exports, is given by

$$\max \pi_h^*(z) = p_h^*(z) y_h^*(z) - \xi w l_h^*(z), \tag{A.17}$$

where ξ is the marginal trade cost, and $l_h^*(z)$ is the labour input used for producing goods that are sold at foreign. An exporter faces the demand for its goods at foreign which is analogous to (A10),

$$y_h^*(z) = [p_h^*(z)]^{-\theta} D \tag{A.18}$$

where $D = P^{*\theta} Y^*$. The profit maximization problem subject to the production function (A11) and the demand for goods at foreign (A18) gives the constant markup price in the foreign market as

$$p_h^*(z) = \left(\frac{\theta}{\theta - 1}\right)\frac{\xi w}{z}. \tag{A.19}$$

From the production function (A11), the demand for goods at foreign (A18), and the price of goods at foreign (A19), we have the labour inputs $l_h^*(z)$ as

$$l_h^*(z) = \xi^{1-\theta}\left(\frac{\theta}{\theta-1}\right)^{-\theta} z^{\theta-1}D, \tag{A.20}$$

and the maximized profit as

$$\pi_h^*(z) = \left(\frac{1}{\theta}\right)\left(\frac{\theta w}{\theta-1}\right)^{1-\theta} \xi^{1-\theta} z^{\theta-1}D. \tag{A.21}$$

A firm exports its goods if the operating profit from exporting can cover the fixed pecuniary cost, f_p. The exporting cutoff technology, z_x, satisfies

$$f_p = \pi_h^*(z_x) = \left(\frac{1}{\theta}\right)\left(\frac{\theta w}{\theta-1}\right)^{1-\theta} \xi^{1-\theta} D {n_x}^{-\frac{1}{\eta}} \tag{A.22}$$

where $\mathrm{n_x}$ is the export ratio, $\mathrm{n_x} = \int_{\mathrm{z_x}}^{\infty} \mathrm{dG(x)} = \mathrm{z_x}^{-\eta(\theta-1)}$ with $\eta = \beta/(\theta-1) > 1$.

From the labour inputs (A15) and (A20), the total labour input in production, L_p, is given by

$$\begin{aligned} L_p = \int l(z)dG(z) &= \int [l_h(z) + m l_h^*(z)] dG(z) \\ &= \left(\frac{\theta w}{\theta-1}\right)^{-\theta} \left(P^\theta Y \Psi_d + \xi^{1-\theta} D \Psi_x\right), \end{aligned} \tag{A.23}$$

where,
$\Psi_d = \int_1^\infty z^{\theta-1}\, dG(z) = \frac{\eta}{\eta-1}$, and $\Psi_x = \int_{z_x}^\infty z^{\theta-1}\, dG(z) = \left(\frac{\eta}{\eta-1}\right) n_x^{(\eta-1)/\eta}$, the elasticity adjusted aggregate productivity of all home producers and exporters, respectively. The required labour input for the export operation H is given by

$$H = \gamma^{-1} EX^{\alpha} \delta^{-\mu}, \tag{A.24}$$

where $\gamma > 0$ measures the efficiency of the government in operating the export process; $\alpha > 2$ so that the labour requirement, H, is increasing and convex with respect to exports, EX; and $\mu > \alpha$ so that H is decreasing and convex with respect to export delay, δ, and is decreasing in δ given EX/δ, exports net of delay costs. The labour market clearing condition is given by

$$L = L_p + H \tag{A.25}$$

where L is the total labour supply at home normalized to $L = 1$.

From the demand for goods at foreign (A18) and its price (A19), the total export of home is given by

$$EX = \int_{z_x}^{\infty} p_h^*(z) y_h^*(z) dG(z) = \left(\frac{\theta w}{\theta - 1}\right)^{1-\theta} \xi^{1-\theta} D \Psi_x. \tag{A.26}$$

Similar to the price of home goods in the foreign, we assume that the price of imported good is given by

$$p_f = \xi p_f^* \tag{A.27}$$

where p_f^* is the price of imported good in the foreign country. From the demand for imported goods (A10) and its price (A27), the total import is given by

$$IM = p_f y_f = \xi^{1-\theta} p_f^{*1-\theta} P^{\theta} Y. \tag{A.28}$$

From the total export and import, (A26) and (A28), we have the balanced trade condition $EX = IM$ as

$$\left(\frac{\theta w}{\theta - 1}\right)^{1-\theta} \xi^{1-\theta} D\Psi_x = \xi^{1-\theta} p_f^{*1-\theta} P^{\theta} Y. \tag{A.29}$$

Optimal f_p

We can rewrite the price index (A8) with the prices of home and imported goods, (A14) and (A27), as

$$P^{1-\theta} = \left(\frac{\theta w}{\theta - 1}\right)^{1-\theta} \Psi_d + \xi^{1-\theta} p_f^{*1-\theta}. \tag{A.30}$$

Multiplying both sides with $P^{\theta}Y$, and applying the total labour input in production (A23) in the price index (A30) with the balanced trade condition of (A29), we have the budget constraint

$$PY = \left(\frac{\theta}{\theta - 1}\right) w L_p. \tag{A.31}$$

We can rewrite the required labour input for the export operation H with the total export (A26) as

$$H = \gamma^{-1} \delta^{-\mu} \left[\left(\frac{\theta w}{\theta - 1}\right)^{1-\theta} \xi^{1-\theta} D\Psi_x\right]^{\alpha} . \tag{A.32}$$

We have 7 equations: (i) the productivity of the marginal exporter (A22); (ii) the labour market clearing condition (A25); (iii) the total export (A26); (iv) the balanced trade (A29); (v) the price index (A30); (vi) the budget constraint

(A31); and (vii) the required labour input for the export operation (A32) to solve for 7 variables, Y, P, w, Ψ_x, L_p, H and EX. Taking the total differentiation of these equations, we have

$$\widehat{f_p} = -(\theta-1)\hat{w} - (\theta-1)\hat{\delta} - \left(\frac{1}{\eta-1}\right)\widehat{\Psi}_x, \tag{A.33}$$

$$0 = L_p\hat{L}_p + H\hat{H}, \tag{A.34}$$

$$\widehat{EX} = -(\theta-1)\hat{w} - (\theta-1)\hat{\delta} + \widehat{\Psi}_x, \tag{A.35}$$

$$\theta\hat{P} + \hat{Y} = -(\theta-1)\hat{w} + \widehat{\Psi}_x, \tag{A.36}$$

$$\hat{P} = \lambda\hat{w} + (1-\lambda)\hat{\delta}, \tag{A.37}$$

$$\hat{P} + \hat{Y} = \hat{w} + \hat{L}_P, \tag{A.38}$$

$$\hat{H} = -\alpha(\theta-1)\hat{w} - a(\theta-1)\hat{\delta} + \alpha\widehat{\Psi}_x - \mu\hat{\delta} - \mu\hat{\gamma}, \tag{A.39}$$

where $\lambda = \left(\frac{\theta w}{\theta-1}\right)^{1-\theta}\Psi_d P^{1-\theta}$. Using these equations, we can obtain the following two equations to solve for $\hat{Y}$. From (A33), (A36), and (A37), we have

$$\begin{aligned} 0 = \hat{Y} + [\theta\lambda + \eta(\theta-1)]\hat{w} + (\eta-1)\widehat{f_p} \\ + [(\eta-1)(\theta-1) + \theta(1-\lambda)]\hat{\delta}. \end{aligned} \tag{A.40}$$

Rearranging (A39) with the other equations, we have

$$0 = \left[L_p + \alpha H\right]\hat{Y} + \left[\alpha\theta\lambda H - (1-\lambda)L_p\right]\hat{w} - H\hat{\gamma} \\ + \left[(1-\lambda)L_p - \alpha\theta\lambda H - (\mu - \alpha)H\right]\hat{\delta}. \tag{A.41}$$

Terms-Of-Trade, and Effective Productivity Gain

Let's define the terms-of-trade as the export to import price ratio,

$$TOT = \frac{P_X}{p_f} = \left(\frac{\theta}{\theta - 1}\right) {\Psi_x}^{-\left(\frac{1}{\theta-1}\right)} \left(\frac{w}{p_f^*}\right), \tag{A.42}$$

where P_X is the export price index,

$$P_X = \left\{\int [p_h^*(z)]^{1-\theta} dG(z)\right\}^{\frac{1}{1-\theta}} = \xi \left(\frac{\theta w}{\theta - 1}\right) {\Psi_x}^{-\left(\frac{1}{\theta-1}\right)}. \tag{A.43}$$

From the price index (A30) with the terms-of-trades (A42) and the export price index (A42), we have

$$\left(\frac{\theta}{\theta-1}\right)\left(\frac{w}{P}\right) = \left[\left(\frac{\eta}{\eta-1}\right) + \left(\frac{\xi p_f^*}{\left(\frac{\theta w}{\theta-1}\right)}\right)^{1-\theta}\right]^{\left(\frac{1}{\theta-1}\right)} \\ = \left[\left(\frac{\eta}{\eta-1}\right) + \xi^{1-\theta}\Psi_x TOT^{\theta-1}\right]^{\left(\frac{1}{\theta-1}\right)} \tag{A.44}$$

From the budget constraint (A31) with (A44), we have

$$Y = \left(\frac{\theta}{\theta-1}\right)\left(\frac{w}{P}\right) L_p \\ = \left[\left(\frac{\eta}{\eta-1}\right) + \xi^{1-\theta}\Psi_x TOT^{\theta-1}\right]^{\left(\frac{1}{\theta-1}\right)} L_p. \tag{A.45}$$

From (A40) and (A41), we have

$$\frac{\partial \ln w}{\partial \ln f_p} = -\frac{(\eta - 1)\left(L_p + \alpha H\right)}{[(\eta + \lambda)(\theta - 1) + 1]L_p + \alpha\eta(\theta - 1)H} < 0. \tag{A.46}$$

From (A33) and (A46), we have

$$\begin{aligned} \frac{\partial \ln \Psi_x}{\partial \ln f_p} &= -(\eta - 1)\left[(\theta - 1)\frac{\partial \ln w}{\partial \ln f_p} + 1\right] \\ &= -\frac{(\eta - 1)\left\{[(\theta - 1)(1 + \lambda) + 1]L_p + \alpha(\theta - 1)H\right\}}{[(\eta + \lambda)(\theta - 1) + 1]L_p + \alpha\eta(\theta - 1)H} \\ &< 0. \end{aligned} \tag{A.47}$$

From the definition of TOT (A42) together with (A46) and (A47), we have

$$\begin{aligned} \frac{\partial \ln TOT}{\partial \ln f_p} &= \frac{\partial \ln w}{\partial \ln f_p} - \frac{1}{\theta - 1}\frac{\partial \ln \Psi_x}{\partial \ln f_p} \\ &= \left(\frac{\eta - 1}{\theta - 1}\right)\frac{[(\theta - 1)\lambda + 1]L_p}{[(\eta + \lambda)(\theta - 1) + 1]L_p + \alpha\eta(\theta - 1)H} \\ &> 0. \end{aligned} \tag{A.48}$$

From (A35) and (A48), we have

$$\begin{aligned} \frac{\partial \ln EX}{\partial \ln f_p} &= -(\theta - 1)\left[\eta\left(\frac{\partial \ln w}{\partial \ln f_p}\right) + \frac{\eta - 1}{\theta - 1}\right] \\ &= -\frac{(\eta - 1)[(\theta - 1)\lambda + 1]L_p}{[(\eta + \lambda)(\theta - 1) + 1]L_p + \alpha\eta(\theta - 1)H} \\ &< 0. \end{aligned} \tag{A.49}$$

From (A39) and (A49), we have

$$\frac{\partial \ln H}{\partial \ln f_p} = \alpha \frac{\partial \ln EX}{\partial \ln f_p} = -\frac{\alpha(\eta - 1)[(\theta - 1)\lambda + 1]L_p}{[(\eta + \lambda)(\theta - 1) + 1]L_p + \alpha\eta(\theta - 1)H} < 0. \qquad \text{(A.50)}$$

This gives, from (A34),

$$\frac{\partial \ln L_p}{\partial \ln f_p} = -\left(\frac{H}{L_p}\right)\frac{\partial \ln H}{\partial \ln f_p} = \frac{\alpha(\eta - 1)[(\theta - 1)\lambda + 1]H}{[(\eta + \lambda)(\theta - 1) + 1]L_p + \alpha\eta(\theta - 1)H} > 0. \qquad \text{(A.51)}$$

From (A40) and (A41) we have

$$\frac{\partial \ln Y}{\partial \ln f_p} = \frac{B_f}{B_Y}, \qquad \text{(A.52)}$$

where

$$B_f = (\eta - 1)\left[\alpha\theta\lambda H - (1 - \lambda)L_p\right]. \qquad \text{(A.53)}$$

$$B_Y = [\eta(\theta - 1) + (\theta - 1)\lambda + 1]L_p + \alpha\eta(\theta - 1)H > 0, \qquad \text{(A.54)}$$

With $B_f = 0$ we have the equilibrium L_p and H as

$$L_p = \frac{\alpha\theta\lambda}{\alpha\theta\lambda + 1 - \lambda}, \qquad \text{(A.55)}$$

$$H = \frac{1 - \lambda}{\alpha\theta\lambda + 1 - \lambda}. \qquad \text{(A.56)}$$

A Delay Reduction

From the condition for the optimal f_p, $B_f = 0$, we have

$$0 = L_p\hat{\lambda} - \alpha\theta\lambda\hat{L}_p. \tag{A.57}$$

From the definition of λ and the price index (A30), we have

$$\hat{\lambda} = -(\theta - 1)(1 - \lambda)(\hat{w} - \hat{\delta}). \tag{A.58}$$

From (A37), (A38), and (A41) with $f_p = f_p^*$, we have

$$\hat{L}_p = -(1 - \lambda)\hat{w} + \left[(1 - \lambda) + \frac{(\mu - \alpha)H}{L_p + \alpha H}\right]\hat{\delta} + \frac{H}{L_p + \alpha H}\hat{\gamma}. \tag{A.59}$$

Applying (A57) and (A58) to (A59), we have

$$\begin{aligned} 0 = \hat{w} - \left\{1 + \frac{\alpha\theta\lambda(\mu - \alpha)H}{[1 + (\alpha - 1)H](1 - \lambda)\phi}\right\}\hat{\delta} \\ - \frac{\alpha\theta\lambda H}{[1 + (\alpha - 1)H](1 - \lambda)\phi}\hat{\gamma}, \end{aligned} \tag{A.60}$$

where $\phi = [1 + (1 - \lambda) + \theta(\alpha\lambda - 1)]L_p > 0$. From (A40) and (A41) with $f_p = f_p^*$ we have

$$\begin{aligned} 0 = [\eta(\theta - 1) + \theta\lambda]\hat{w}(\eta - 1) + \widehat{f_p^*} + \frac{\mu H}{1 + (\alpha - 1)H}\hat{\gamma} \\ + \left\{\eta(\theta - 1) - \theta\lambda + 1 + \frac{(\mu - \alpha)H}{1 + (\alpha - 1)H}\right\}\hat{\delta}. \end{aligned} \tag{A.61}$$

From (A60) and (A61), we have

$$\frac{\partial \ln f_p^*}{\partial \ln \delta} = -\left(\frac{1}{\eta - 1}\right)\{2\eta(\theta - 1) + 1 + \left[1 + \frac{\alpha\theta\lambda[\eta(\theta - 1) + \theta\lambda]}{(1 - \lambda)\phi}\right]\Bigg\}\frac{(\mu - \alpha)H}{1 + (\alpha - 1)H} < 0. \tag{A.62}$$

Efficiency Improvements

From (A60) and (A61), we have

$$\frac{\partial \ln f_p^*}{\partial \ln \gamma} = -\left(\frac{1}{\eta - 1}\right)\left\{1 + \frac{\alpha\theta\lambda[\eta(\theta - 1) + \theta\lambda]}{(1 - \lambda)\phi}\right\}\frac{\mu H}{1 + (\alpha - 1)H} < 0. \tag{A.63}$$

Responses of Exports: From (A35), (A36), and (A37), we have

$$\widehat{EX} = -\eta(\theta - 1)\hat{w} - (\eta - 1)\widehat{f_p} - \eta(\theta - 1)\hat{\delta} = \hat{Y} + \theta\lambda(\hat{w} - \hat{\delta}) + \hat{\delta}. \tag{A.64}$$

With (A40), we can rewrite it as

$$\widehat{EX} = \frac{1}{\eta(\theta - 1) + \theta\lambda}\left[\eta(\theta - 1)\hat{Y} - (\eta - 1)\theta\lambda\widehat{f_p} - \eta(\theta - 1)(2\theta\lambda - 1)\hat{\delta}\right]. \tag{A.65}$$

Exports are increasing in the income of the country, but decreasing in the pecuniary cost, f_p, and exporting delay, δ.

A Delay Reduction

Applying (A41) and (A62) with $f_p = f_p^*$ to (A65), we have

$$\left.\frac{\partial \ln EX}{\partial \ln \delta}\right|_{f_p = f_p^*} = 1 + \left[1 + \frac{\alpha\theta^2\lambda^2}{(1-\lambda)\phi}\right]\frac{(\mu-\alpha)H}{1+(\alpha-1)H} > 0. \tag{A.66}$$

An Efficiency Improvement

Applying (A41) and (A62) with $f_p = f_p^*$ to (A63), we have

$$\left.\frac{\partial \ln EX}{\partial \ln \gamma}\right|_{f_p = f_p^*} = \left[1 + \frac{\alpha\theta^2\lambda^2}{(1-\lambda)\phi}\right]\frac{H}{1+(\alpha-1)H} > 0. \tag{A.67}$$

Delay Reduction Coordination

By taking $\widehat{\delta^*} \neq 0$ in 7 key equations for the equilibrium and using a version of (A41) with $f_p = f_p^*$, we have

$$\hat{Y}\Big|_{f_p = f_p^*} = \frac{H}{1+(\alpha-1)H}\left[(\mu-\alpha)\hat{\delta} + \hat{\gamma} - \alpha\widehat{\delta^*}\right]. \tag{A.68}$$

Chapter 3: Exports Sensitivity to Time Delays and its Impact on the Patterns of Trade

3.1. **Introduction**

More than 50 years of extensive use of the gravity model have shown that geographical distance is one of the most robust determinants of international trade. Distance has been adopted as the natural proxy for transportation costs. As such costs are known to be increasing with distance. However, other important impediments to trade are also captured by distance, such as cultural differences between countries and time in transit. In particular, the impact of time in transit on exports has recently received increasing attention in the literature (see for example: Venables 2001; Harrigan and Venables 2006; Evans and Harrigan 2005 and Hummels and Schaur 2013). Time, as explained in some detail in Chapter 1, constitutes an additional trade cost to exporters. However, not all products/industries are equally sensitive to time. Evans and Harrigan (2005) identify differences in sensitivity to time across products in the apparel industry based on how often they need to be replenished in the stock of retailers. Djankov, Freund, and Pham (2010) use maximum storage period as a measurement of time sensitivity across agricultural products. More recently, Hummels and Schaur (2013) create a ranking of industries according to their sensitivity to time delays. They estimate industry time sensitivity using the difference in probability across products of being delivered by air. Airborne transportation is considerably faster than other transportation modes, but many times more expensive. Thus, everything else equal, a higher probability that a product is delivered by air is an indication of a higher sensitivity to time delays.

Timeliness is clearly an important factor in international trade, and the demand for timeliness appears to be increasing over time. During the last decades new managerial practices have risen, where the main focus is to increase efficiency through the reduction in inventory holding. This is typically achieved by speeding up and increasing the frequency of deliveries, and improving the synchronisation between different stages in the supply chain. In particular, managerial technologies like just-in-time operations, which refer to the reduction in inventory holding of intermediate goods, and lean retailing, which pursues the same objective but for final products, are believed to have increased the demand for timeliness (Evans and Harrigan 2005). In addition, the internationalisation of the demand for time sensitive goods may have been facilitated by improvements in information, communication and transportation technologies. Information and communication technologies help control and synchronise cross-borders supply chains, while new transportation technologies have made international transportation cheaper and faster over time. With the increasing international demand for timeliness firms may perceive as an advantage to locate production of time sensitive products closer to large demand centres. Then, it could be argued that, as the demand for timeliness increases, time sensitivity may impact on the geographical patterns of trade by producing an agglomeration effect of export supply towards the demand centre. My first objective is to test this hypothesis empirically.

Evans and Harrigan (2005) find that time sensitivity produced an agglomeration effect towards the U.S. in the apparel industry between 1991 and 1998. However, limited to only one industry and a few selected countries, their results provide limited scope for generalizable lessons. In an effort to extend their analysis, I use industry level U.S. import data from all countries exporting to the U.S. and the cross-industry time sensitivity indicator introduced by Hummels and Schaur (2013), to estimate whether time sensitivity has produced an agglomeration effect towards the U.S. between 1991 and 2006. The results suggest that the supply of exports in industries that are relatively more sensitive to delays moved closer to the U.S. during this period. These results provide statistical evidence suggesting that the negative effect of distance on trade in time sensitive industries is strengthening over time, possibly motivated by the introduction of new technologies that increase the demand for timeliness in trade.

In addition, the new information, communication and transportation technologies that have facilitated the internationalisation of the demand for time sensitive goods may have also increase their share in total trade. Then, it can be argued that the incidence of the time sensitivity agglomeration effect described earlier would be growing over time, increasing the overall marginal negative effect of distance on trade. My second step in this study is to test the relative change in the volume of trade in time sensitive industries. The results show that, on average, the growth of trade between 1991 and 2006 has been higher the higher the industry sensitivity to time delays. Also, the share of trade in time sensitive industries increased from 37% in 1991 to 54% in 2006.

These results are relevant in the debate about the “death of distance” in international trade. Improvements in technologies that facilitate international exchange of information and transportation technologies that make transportation faster and cheaper are expected to reduce the marginal negative effect of distance on trade over time. However, the effect of distance on trade has been very persistent, and some studies have even found this effect to be growing over time, which has been named in the literature as the “the distance puzzle”. The results in this study provide one possible explanation to this puzzle. The strengthening of the time sensitivity agglomeration effect coupled with the growing share of trade in time sensitive industries may be increasing the overall marginal negative effect of distance on trade. New technologies that are believed to produce the death of distance might be actually strengthening its hindering impact on trade.

The last objective of my study departs from the geographical implications of time sensitivity on the patterns of trade. Previous studies suggest that developed countries enjoy a comparative advantage in the production of time sensitive products (see Venables 2001 and Deardorff 2002). This proposition adds an important dimension to how time sensitivity may impact on the patterns of trade. However, the notion that developed countries have a comparative advantage in the production of time sensitive products has not been empirically tested in the literature so far. To fill this gap in the literature in this study I investigate whether high-income countries specialise in the production of products that are more sensitive to time delays. The results are striking. High-income countries not just specialise in time sensitive products but this pattern of specialization appears to be strengthening over time.

The remainder of this study proceeds as follows. The next section contains a review of the literature on time sensitivity and the distance effect on trade. Section 3.3 describes the objectives and empirical methodology. Section 3.4 summarizes the data. Section 3.5 discusses the results and the last section presents some concluding remarks.

3.2. Literature Review

The distance effect and the role of delivery delays

Disdier and Head (2008) investigated the robustness of geographical distance as a determinant of International Trade by conducting a meta-analysis of 1467 estimates of distance from 103 different research articles between 1870 and 2001. Their findings show that on average, the elasticity of trade with respect to distance is -0.9, with 90% of the estimations falling between -0.28 and -1.55. These results imply that a 10% increase in distance between two trading partners reduces bilateral trade by an impressive 9%. A plausible explanation to this robust large negative effect of distance on trade may rely on the fact that geographical separation between exporters and importers captures several of the most important factors producing frictions in International Trade.

Distance relates to at least three different dimensions of international trade costs: (1) transportation fees, (2) cultural differences and (3) delivery delays. The cost of international transportation between trading partners is undoubtedly one of the main determinants of trade, but it is normally not directly included in empirical models. The reason is two-fold: first, it is not an easy variable to measure, mainly because of the significant variability of rates across cargos and also because of their inherent private nature; and second, because its negative impact on trade is, at least in large proportion, captured by geographical distance between countries (Hummels 2007), which is readily observable. In spite of its important role, the large magnitude of the trade elasticity in relation to distance may not just capture transportation costs. International freight costs have declined significantly in the second half of the twentieth century but the effect of distance on trade has remained persistently high. This suggests that other trade frictions captured by distance may not be weakening or may even be strengthening over time.[40]

The second factor captured by distance is cultural difference between countries, which may not only represent a source of friction in trade negotiations but may also affect the patterns of demand for taste-dependent goods. Blum and Goldfarb (2006) argue that, despite the forces of globalisation, some products are still very sensitive to cultural differences, which is also reflected on the distance effect on trade. To test this, they examine the patterns of trade in digital products, such as music or games, which are accessible on the Internet and are a clear example of products that are taste-dependent. They show that, in spite of their easy global accessibility, these products tend to be traded primarily between nearby countries. They find that a 1% increase in physical distance between trade partners, after controlling for language, income, and other key trade determinants, reduces access to these products' websites by 3.25%.

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[40] Most of this decline corresponds to technological advances and a dramatic drop in airborne shipment costs. This have been accompanied by a continuous decline in ocean freight costs, particularly over the last two decades of the twentieth century (Hummels 2007).

The third distance-related determinant of international trade, which has been receiving increasing attention in the literature, is timeliness in export deliveries. Longer distances are normally associated with higher time delays to deliver the goods to the importer, and time is a source of additional important costs in trade. Hummels and Schaur (2013) explain that the costs produced by time delays can be divided into costs of inventory holding and depreciation costs. Inventory holding includes not only the inventory costs of the goods in transit, but also the excess inventories that must be held by the importer to accommodate possible unexpected delays. Depreciation costs, on the other hand, refer to any time related loss of value of the goods while in transit. Examples of this include the speed at which fresh products deteriorate (e.g., vegetables); how quickly electronic products lose value in highly competitive technologically driven markets; and fashion goods that lose value as consumer preferences change quickly. Harrigan and Venables (2006) also consider the costs of uncertainty that are originated by time delays. The longer it takes to complete a trade operation the more firms need to anticipate production decisions. Hence, in the presence of demand or cost uncertainties having to bring forward production decisions results in an increase of the costs associated to those uncertainties.

International time delays clearly represent an additional cost to trade, and they increase with distance. However, the estimation of how delays affect trade by just considering geographical distance is not as simple as it might first appear. There are at least two elements that make this analysis more complex. The first relates to the existence of different transportation modes, while the second refers to the variation of time sensitivity across products. In the next paragraph I provide a brief description of the first factor. Then I move to the idea that not all products are equally sensitive to time delays, which is at the core of this study.

Distance between trade partners is invariant. However, an exporter always has options in terms of transportation modes, which vary not only in terms of costs but also in terms of delivery delays. Hummels and Schaur (2013) studied the implications of alternative modes of international transportation on trade, with particular attention on the decision that exporters make when they opt between seaborne and airborne shipments. Planes reduce international transportation time delays considerably, in comparison to alternative transportation modes, but they impose significantly higher cost on shippers. Hence, even though there is a clear trade-off between transportation modes, independently of the exporters' choice the cost of trading is always increasing in distance.

The second element to be considered in the analysis of how delivery delays relate to distance is that not all products are equally affected by transportation delays. The costs to shippers associated to time delays will vary considerably across products depending on characteristics that make certain products more time sensitive than others. One specific example relates to the difference in time sensitivity across perishable goods, such as vegetables and other food products. The Food and Agricultural Organisation of the United Nations (FAO) reports the approximate storage life of different fruits and vegetables. For example, the range of storage life can go from very time insensitive products like dates, with a maximum storage life of between 180 and 360 days, to very time sensitive ones like blackberries, which can be in storage for only 2 to 3 days (FAO 2004).[41]

The study of time sensitivity across products has been approached from a variety of perspectives (see for example Venables 2001, Deardorff 2002, Evans and Harrigan 2005 and Hummels and Schaur 2013). The papers of Evans and Harrigan (2005) and Hummels and Schaur (2013) are particularly

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[41] These approximate storage times correspond to the preservation of the fruits and vegetables under specific conditions of temperature and humidity. "Manual for the preparation and sale of fruits and vegetables", (FAO 2004). http://www.fao.org/docrep/008/y4893e/y4893e06.htm

interesting, as they propose two alternative ways to measure differences in time sensitivity across products and industries, respectively. Evans and Harrigan measure time sensitivity of apparel products based on their restocking frequency, which they observe from micro data provided by a major store chain in the U.S. While, on the other hand, Hummels and Schaur take advantage of the trade-off between transportation modes to measure time sensitivity. The additional cost accepted by shippers to speed up deliveries represents the value given to timeliness in certain goods and a measurement of how products differ in their sensitivity to delays.

The distinction of differences in time sensitivity across products and industries is a key element in the analysis of how geographical distance affects bilateral trade and how its effect has evolved over time. In particular, the differences in time sensitivity across industries become crucial when examining how recent improvements in technology may have affected the elasticity of trade in respect to distance, which is the topic that I introduce next.

The opposing impact of new technologies on the distance effect

New technologies have continuously reduced transportation costs, made international shipments faster and brought cultures closer. For these reasons, and fairly intuitively, new technologies and the effects of globalization are believed to make the world a smaller place. Thus, it seems reasonable to believe that the effect of distance on trade would also weaken over time.

The idea of the distance effect disappearing over time by the forces of new technologies was popularised in 1997 by Frances Cairncross as the "death of distance" in a very influential, although mostly anecdotal work. In 1995 the World Bank had already introduced the concept of a decreasing effect of distance on international trade motivated by technological improvements. Other studies provide further support (see for example, Yotov 2012 and Lin 2013). However, not only has the negative effect of geographical distance on trade, as estimated by the gravity model, remained persistently high, but some studies have also found its effect to strengthen over time. These findings have given rise in the literature to what is called "the distance puzzle". Brun *et al.* (2005) used a panel of 130 countries between 1962 and 1996 to estimate the evolution of the distance effect on bilateral trade. Their findings show that the distance effect actually increased over that period. More recently Disdier and Head (2008) found that the distance effect decreased between 1870 and 1950 but then began to increase. Berthelon and Freund (2008) studied the variation of the distance effect between 1985 and 2005 with a dataset disaggregated at the 4-digit SITC level. Their estimations show that the negative impact of distance on trade significantly increased in almost 40% of the industries.

How can it be explained that, in spite of improved international communication and transportation technologies, the effect of distance on trade has not declined over time? Interestingly, the answer may also rely on technological improvements. Venables (2001) studies the relationship between new technologies, time sensitivity and their potential implications on the distance effect. New technologies help speed up some of the processes in the supply chain through different channels. One of the ways this happens is by faster exchanges of information that help accelerate and improve the processing of orders, payments and monitoring along with other formal and informal procedures that occur within the firm or across the supply chain. For example, in an international vertical production chain, faulty supplies can be rapidly detected through the implementation of improved stock controls. Such rapid detections may, as a consequence, facilitate timely solution responses, which manifest themselves in the form of quick restocking.

Based on these effects Venables investigates whether some elements of the supply chain that become faster have any impact on the marginal cost of time delays on other stages of the supply process. Considering international transportation as one of these stages, he concludes that technological improvements that speed up some processes of the supply chain (e.g., information technology in production) are expected to move those activities closer to where the demand is positioned.

As an example, the just-in-time managerial technology introduced in the 1980s puts the focus on improving information and communication processes in the supply chain to reduce inventory holding. Being able to respond to demand instantly implies producing and delivering only when it is needed, reducing significantly the cost of overstocking in anticipation of uncertain demand or as a result of inefficiencies in the process of production (Hutchins, 1999). Just-in-time technology increases pressure for timely production and deliveries at every stage of the supply chain, which consequently pushes the supply closer to the demand, thus producing an agglomeration effect (Venables 2001).[42]

Evans and Harrigan's (2005) examine the case of lean retailing, which is the equivalent to just-in-time but in the final commercialization stage of the supply chain. This business practice introduced in the 1990s consists of a faster response to changes in consumers' demand while minimizing inventory holding. As a consequence, suppliers who participate in international lean retailing need to respond quickly to more frequent orders from retailers. Such increase in the demand for timeliness may also strengthen the perception among suppliers of the advantage of locating production closer to the demand centre. Evans and Harrigan (2005) show that U.S. imports supply of time sensitive apparel products shifted to countries located closer to the U.S. between 1991 and 1998, which they explain by the rise of lean retailing in this industry. Hence, they conclude that, over time as new technologies are introduced, the negative distance effect on trade is reinforced in apparel products that are more sensitive to delays.

[42] An international agglomeration effect refers to a process of geographical concentration of export supply towards the demand centre.

Similarly to the effect of lean retailing in the last stage of the supply chain, the introduction of just-in-time operations have increased the demand for timeliness throughout the entire vertical production chain (Venables 2001), which may contribute to the particularly high time sensitivity of intermediate goods.[43] However, the international trade of intermediate goods has increased significantly in the last decades (E. Helpman and Trefler 2006). How can a higher demand for timeliness in the production process go together with a higher fragmentation of production across countries? A potential answer is again new technologies, in this case, speeding up international transportation (Hummels 2007).

Therefore, new technologies may produce two opposing effects on how the impact of distance on trade has evolved over time in time sensitive industries. On the one hand, the recent introduction of new managerial, information and communication technologies may have increased the demand for timeliness as proposed by Venables (2001). This effect may have raised the marginal cost of international transportation time delays, thus reinforcing the negative effect of distance on trade in time sensitive industries. On the other hand, technological innovations may have also facilitated the commercialisation of time sensitive products from countries located further away by, for example, reducing the cost of international transportation speed as observed by Hummels (2007). Whether the negative effect of distance in time sensitive products will increase or not over time is unclear, especially

[43] Hummels and Schaur (2013) explain that intermediate goods are particularly time sensitive because in international vertical production integrations, inventory holding and depreciation cost at early stages of the production process, as well as demand uncertainty with the final product, accrue throughout the duration of the production chain. In addition, late arrival of components as well as faulty pieces with long replacement delays may idle entire assembly plants.

considering the significant increase in airborne international shipments in the last decades, which reduces considerably the costs of international shipment delays. Furthermore, new transportation and communication technologies may have facilitated the internationalisation of trade in time sensitive product, increasing the share of these products in total trade. Hence, conditional on whether the agglomeration effect of time sensitivity has strengthening or weakening over time, a higher share of time sensitive products in total trade may offer a potential explanation to why the overall negative effect of distance on trade has not declined over time.

Specialisation in time sensitive industries

Another aspect of how time sensitivity affects International Trade relates to the patterns of trade specialisation in time sensitive products across countries. The introduction of new technologies may increase the demand and facilitate the international trade of time sensitive products. However, it is unclear whether all countries are equally capable of benefiting from these changes in technology by producing time sensitive goods.

Various theoretical studies that investigate the agglomeration effect of time sensitivity focus on the trade-off between production costs and delays. In these models (e.g., Venables 2001 and Evans and Harrigan 2005), more developed (higher-wage) countries are assumed to be closer to large demand centres while low-wage countries are located in the periphery. According to these models, time sensitivity gives firms an incentive to locate in more developed countries, which facilitates a reduction in trade delays, but at the cost of paying higher wages.[44] Therefore, Venables (2001) concludes that the

[44] These studies also assume a potential causal relationship between the time sensitivity agglomeration effect and higher wages. Firms agglomerating near the final demand to reduce trade delays may tend to bid up wages in those locations.

production in time sensitive industries is more likely to be entrenched in high-income countries. In these studies it is assumed that developed countries enjoy a geographical location advantage for the production of time sensitive products. However, independently of the geographical location, are there other country specific characteristics suggesting that more developed countries have a comparative advantage and will specialise in time sensitive products?

Evans and Harrigan (2005) assume that not all firms possess the necessary technological capacity to engage in the production of time sensitive goods. However, they do not specify what conditions separate capable from incapable firms. In addition, their research does not specify whether those conditions are linked to country specific characteristics such as technological development or differences in factor endowments. Deardorff (2002) on the other hand, directly assumes that, independently of any distance effect, developed countries will have a comparative advantage in the production of time sensitive products. He develops a production model that incorporates this concept based on the idea that reductions in production delays are largely achieved by increasing inputs that are intensive in human and/or physical capital.

Deardorff's assumption finds support in previous studies that analyse the strategies followed by firms to reduce production delays. Milgrom and Roberts (1990) review a series of papers that provide data on real cases of firms modernising their production processes, in particular, speeding up production. They observe that firms achieve reductions in production delays by incorporating inputs that are capital intensive. Their focus is on three different actions taken by firms to modernise and speed up production. First, they consider the collection, organisation and communication of data, which is modernised through the introduction of computer networks and electric data transmission systems. Second, product design and development are modernised by incorporating computer-aided design. And the third action they consider is flexible manufacturing,[45] which is achieved by the introduction of robots and other programmable production equipment.

All these actions taken by firms to modernise and speed up production, which are particularly prevalent in industries that are sensitive to delays, require capital-intensive equipment and skilled labour, factors that developed nations possess in abundance. Deardorff, in line with these observations, concludes that developed countries will specialise in the production of time sensitive goods. However, this hypothesis has not been systematically investigated in the literature so far. The empirical examination of this hypothesis has important implications for the analysis of the patterns of trade. It may also contribute to our understanding of the challenges faced by developing countries in their effort to increase their participation in the global market, especially if the share of time sensitive products in total trade is increasing over time.

3.3. **Objectives and Methodology**

The agglomeration effect of time sensitivity

My first objective is to investigate whether the negative effect of distance on trade in time sensitive industries has strengthened over time. This implication of time sensitivity on the patterns of trade has not been comprehensively tested in the literature so far. The only study that, to my knowledge, has empirically investigated this possible effect of time sensitivity, although with limited scope of analysis, is Evans and Harrigan (2005).

To respond to this limitation my study builds on Evans and Harrigan's work in two very important aspects. First, Evans and Harrigan select a limited

[45] Flexible production refers to a production technique that incorporates flexible machine tools and programmable multitask equipment that can be quickly and cheaply switched from one task to another. This equipment permits firms to produce a variety of outputs efficiently in very small batches.

number of countries to compare exports to the U.S. between only two regions in the world, Asia and Central America and The Caribbean. This approach, although illustrative in the context of their theoretical work, may be affected by selection bias and may not be representative of changes in patterns of trade in the rest of the world. To generalise their results to all countries and avoid the potential problems created by selection bias I estimate the change over time in the agglomeration effect of time sensitivity accounting for all countries exporting to the U.S.[46] Second, their study only focuses on the apparel industry. They justify this single-industry approach based on the following reasons. First, their indicator of time sensitivity only applies to the U.S. apparel industry, and second, their theoretical and empirical interest is on the rise of lean retailing in this industry in the 1990s, which they use as a stylised example of how new technologies may increase the demand for timeliness in trade.

Lean retailing is certainly one of the forces increasing the demand for timeliness since its introduction in the 1990s, and it potentially produces an agglomeration effect towards world demand centres. However, focusing only on apparel lean retailing limits the scope of the analysis for at least two reasons. First, lean retailing affects other industries other than apparel, which may perceive a higher or lower cost derived from time delays as compared to the apparel industry. For example, in addition to apparel lean retailers such as Macy's and the Gap, large firms in other industries like Amazon in the books industry, Home Depot in the home and construction industry and Wal-Mart, which operates with a wide range of products are also important examples of lean retailing (Myerson 2014). Wal-Mart is one of the most emblematic cases of lean retailing in the world, and a clear example of how the control of the

[46] The choice of U.S. imports data responds to the unavailability of other markets' trade statistics at the classification and disaggregation levels that are compatible with the time sensitivity indicator used in this study.

supply chain has moved in the last decades from manufacturers to large retailers. Improvements in technology such as the introduction in the 1980s of the bar code facilitated this process. It allowed retailers to accurately forecast sales, minimise inventories and exchange production and sales information automatically with local and international suppliers (Appelbaum and Lichtenstein 2006). Clearly lean retailing is a managerial practice that has expanded to a wide range of industries in the last decades. Then, it could be argued that the incentives produced by lean retailing to agglomerate towards the demand centre observed in the apparel industry may not necessarily be the same across other sectors.

The second reason why focusing only on the apparel lean retailing may limit the scope of the analysis is that this managerial practice is not the only force increasing the demand for timeliness in trade. Other technological innovations, with potential different effects on the marginal cost of distance, such as just-in-time, have also increased the demand for timeliness. Lean retailing and just-in-time operations may not only vary in how they affect the demand for time sensitive goods across industries but their impact on the incentives to agglomerate towards the demand centre may also be different.

In addition to incorporating all exporters to the U.S., I generalise Evans and Harrigan's estimation to 70 different sectors by using the novel time sensitivity indicator introduced by Hummels and Schaur (2013). Then, by extending the study to various industries, the results are not limited to the effect of time sensitivity associated to lean retailing and its particular characteristics in the scope of the apparel industry.

To test whether the negative effect of distance on trade of time sensitive industries has strengthen over time I follow the estimation approach used by Evans and Harrigan (2005). I estimate equation (1) using simple OLS with both exporter and End-Use 5-digit industry fixed effects.

$$\Delta m_{ic} = \alpha + \beta(Proximity_c * TS_i) + \mu_i + \mu_c + \varepsilon_{ic} \tag{1}$$

Where Δm_{ic} is U.S. imports growth between 1991 and 2006 in industry i from country c;[47] $Proximity_c$ represents the inverse of distance between the U.S. and exporter c, the higher the value of proximity the shorter the distance between the U.S. and its trading partner; TS_i is time sensitivity by industry;[48] μ_i and μ_c are industry and exporter fixed effects respectively; α is a constant term and ε_{ic} corresponds to a stochastic error term.

In spite of its simplicity, this methodology accounts for most observable and unobservable forces that may affect import growth. In particular, both country and industry fixed effects control for a series of important factors that may be correlated to the proximity-TS interaction term. For example, country specific characteristics such as changes in factor endowments, level of infrastructure, export delays and government efficiency, amongst other; may affect the capacity of a country to export time sensitive products. Similarly, industry specific effects such as changes in technology, factor intensity, average per-unit value and consumer preferences, among other; may also be correlated with the proximity-TS interaction term. Leaving these and other country and industry specific factors in the error term (i.e. by not controlling for country and industry fixed effects) may result in endogeneity bias.

β is the coefficient of interest. A positive and statistically significant β coefficient would suggest that, on average, imports in time sensitive industries have grown faster from countries located closer to the U.S. than from countries located further away. This would imply that the negative effect of distance on trade in time sensitive industries has strengthened over

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[47] The choice of this period is consistent with the period selected by Hummels and Schaur to produce the time sensitivity indicator (1991-2005).

[48] The industry time sensitivity indicator produced by Hummels and Schaur (2013), TS_i, is a cross-industry variable that is time invariant for the whole period considered in this study.

time.

Relative growth of trade in time sensitive industries

My second objective is to estimate the relative growth of trade in time sensitive industries over time. Various studies (e.g., Venables 2001, Evans and Harrigan 2005 and Hummels and Schaur 2013) suggest that the introduction of new technologies has facilitated the international trade of time sensitive goods. Hence, the introduction of new technologies may have increased the share of trade in time sensitive industries relative to total trade. This potential change in the industrial composition of trade has not been systematically investigated in the literature so far. Determining whether the share of trade in time sensitive industries is increasing over time is important because of its implications on the debate about the death of distance. Assuming that the time sensitivity agglomeration effect is strengthening over time, a rise in the share of time sensitive trade would result in an increase, on average, of the overall marginal trade cost associated to distance.

To calculate the relative growth of trade in time sensitive industries I take the following simple approach: first, I calculate the change in U.S. imports by industry between 1991 and 2006; then, I use OLS to estimate equation (2), which establishes a relationship between imports change by industry and their corresponding time sensitivity level.

$$\Delta m_i = \alpha + \beta(TS_i) + \varepsilon_i \qquad (2)$$

Where Δm_i represents the change in U.S imports in industry i, TS_i is the level of time sensitivity of industry i, α is a constant term and ε_i is a stochastic error term. A positive β in this case will indicate that the growth in trade is higher the higher the sensitivity of industries to time delays.

The pattern of specialisation in time sensitive industries

Studies such as Venables (2001) and Deardorff (2002) suggest that developed countries enjoy a comparative advantage in the production of time sensitive goods. In this section I propose an empirical methodology to explore this hypothesis by analysing the patterns of specialisation in time sensitive industries across countries. In particular, my objective is to estimate whether, independently of the proximity to the demand centre, the share of time sensitive products in total trade is larger in developed countries than in developing ones and whether this share has changed between 1991 and 2006.

Determining whether developed countries have a comparative advantage in the production of time sensitive products incorporates a different dimension to the potential impact of time sensitivity on the patterns of trade. Time sensitivity may not only produce an agglomeration effect towards large demand centres but the production of time sensitive products may be concentrated in high-income countries.

The capacity of a country to produce and export time sensitive goods may be favoured by a series of factors associated to its level of economic development. For example, better transport and ports infrastructure and higher government efficiency are expected to reduce delays during upstream and downstream commercialisation processes. On the other hand, as described in Milgrom and Roberts (1990), other factors such as easy access to new technologies and human and physical capital abundance may facilitate firms' modernisation processes to speed up production. Deardorff (2002) focuses on the factor abundance characteristic of developed countries to posit that high-income countries have a comparative advantage in the production of time sensitive products.[49] To show this, he proposes a production technology

[49] The exact determinants of comparative advantage in time sensitive goods are not empirically investigated in this study. Such an endeavour does not

where a reduction in delays can be achieved by increasing the amount of inputs in the production process. But more importantly, this increase in inputs is not expected to be equal across production factors. His main assumption is that the increase in inputs to reduce delays will be biased towards capital-intensive factors, which developed countries are abundantly endowed with.

To show how increasing production inputs can reduce delays Deardoff proposes the following simple production function where delays are introduced and will behave, at least under certain conditions, as an additional conventional input: $y = f(X, d)$. Where y is output per unit of time, X is a vector of inputs per unit of time and d is the delay between the beginning and the end of the production of one unit of output. For any value of d the function of X can be conventional, but what makes d behave as a conventional production input is the idea that increasing delays will reduce the requirement for other inputs. For example, the use of high technology machinery may be unnecessary if a longer production delay was accepted. This is plausible but it is not necessary always the case along the whole production function.

Under certain conditions, reducing delays may be costless. To illustrate I use the example given by Deardorff (2002). Let us assume that a production process requires 10 different operations where each operation demands one day of labour by a worker. If the production process were conducted sequentially one unit of product would be finished in 10 days. However, if it were possible to conduct the 10 operations simultaneously, 10 workers would be able to produce one unit of output in only one day, without altering the total labour requirement.

Delays however are by assumption, costly in terms of the value of the product. And its marginal cost can be interpreted as a depreciation rate (δ)

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form part of the scope of this work and, in my opinion, needs to be pursued conducting further research.

during the production process. As a consequence, firms will reduce delays at least as far as the reduction is costless. This implies that firms will normally operate where the production function $y = f(X, d)$ is increasing in d, and where d behaves as a conventional production factor. Behaving as any other production input the marginal product of d is expected to be positive and diminishing as its size increases.

Factor prices are given and firms will choose the amounts of inputs required to maximise profits. Deardorff then assumes that, for any given d, the isoquant map of production inputs is conventional. Firms will choose d to maximise profits and, similarly to a change in technology, an increase in delays will shift the isoquant of inputs inward, reducing the cost paid per output unit. However, in line with what Milgrom and Roberts (1990) suggest, Deardorff assumes that the inward shift of the isoquant will not be neutral but rather biased towards using relatively more physical and/or human capital.

What is the optimal production delay that firms will pursue? According to Deardorff's model, increasing delays reduces per unit costs, but delays, as products depreciate at a rate δ during the production process, are also costly. Firms will maximise profits by choosing d where its marginal reduction in inputs costs equals its depreciation rate δ. The reduction in delays will not be equal across firms producing different products. Firms facing the same factor prices and using the same technology but producing goods with different depreciation rates (different time sensitivity) will behave differently. The higher the time sensitivity the higher the profit maximising reduction in delays that firms will wish to achieve by increasing inputs that are intensive in capital. Then, it is reasonable to assume that firms producing in industries that are more sensitive to delays will find and advantage in producing in capital abundant countries. Based on this intuition Deardorff's model offers one potential explanation as to why more developed countries may have a comparative advantage and may specialise in the production of time sensitive products.

Specialisation coefficient

To test this hypothesis I create an indicator that measures the level of country specialisation in exports of time sensitive goods. To construct this indicator I first normalise the time sensitivity coefficients obtained from Hummels and Schaur (2013) to a range between zero and one.

$$TS_i \in [0,1]$$

Where TS is time sensitivity for the i ($i = \{1 \dots n\}$) End-Use 5-digit industry category. Country c total exports to the U.S. (X_c) is then defined as:

$$X_c = \sum_{i=1}^{n} X_{ci}$$

And total country $c's$ time sensitive exports to the U.S. is calculated as the sum of exports weighted by their time sensitivity:

$$X_c^{TS} = \sum_{i=1}^{n} TS_i X_{ci}$$

The level of country c specialisation in time sensitive industries is measured as the share of these industries in total exports:

$$TS\ specialisation\ coefficient = \left(\frac{X^{TS}}{X}\right)_c$$

Finally, to test whether more developed countries specialise in producing time sensitive products I estimate the following OLS regression:

$$\left(\frac{X^{TS}}{X}\right)_c = \propto + \beta(Development)_c + \gamma(Proximity)_c + \varepsilon_c \qquad (3)$$

Where $Development_c$ represents the level of country c economic development and $Proximity_c$ is the inverse of distance between country c

and the U.S. I estimate equation (3) using two alternative measurements of country development, GDP per capita and a categorical variable indicating whether country c is a member of the OECD (The Organization for Economic Cooperation and Development).[50]

α is a constant term and ε_c is a stochastic error term. A positive β coefficient will suggest that more developed countries, independently of their proximity to the U.S., have a comparative advantage and specialise in time sensitive products.[51]

3.4. Data

The time sensitivity indicator I use is from Hummels and Schaur (2013). They construct a ranking of industries according to their time sensitivity by taking advantage of the trade-off that exists between the higher monetary cost and higher speed offered by air transportation versus a low cost but slower delivery of seaborne shipments. Choosing air transportation to speed up deliveries will then imply a higher price to the importer. Hence, whether the exporter chooses this transportation mode or not will mainly depend on four different factors. First, it will depend on the price elasticity of demand of the traded products; second, on their value per unit; third, on the transportation price differential and; four, on how much the importer values a timely delivery. Hummels and Schaur disentangle these four determinants of the air

[50] To see the list of OECD members please visit: http://www.oecd.org/about/membersandpartners/list-oecd-member-countries.htm

[51] Proximity to the U.S. may also be a determinant of a country's specialisation in time sensitive industries. And since it is positively correlated with $GDPC_c$ excluding it from the estimation may produce a misleading β coefficient.

transportation choice to identify how time sensitive products are. Other things equal, the higher the valuation of timeliness, the higher the willingness of importers to pay a higher price in exchange of a rapid delivery.

Hummels and Schaur (2013) develop a theory that formalises the mechanism and factors that are involved in the decision making process of exporters when they choose between seaborne and airborne shipments. They derive the following testable equation:

$$ln\frac{p_{jktc}^{A}q_{jktc}^{A}}{p_{jktc}^{O}q_{jktc}^{O}} = (1-\sigma)ln\left(\frac{p_{jktc}^{A}}{p_{jktc}^{O}}\right) - \sigma ln\left(\frac{f_{jktc}^{A}}{f_{jktc}^{O}}\right) + \sigma\tau\left(days_{jc}^{O}-1\right) + \varepsilon_{jktc}$$

Where $ln\frac{p_{jktc}^{A}q_{jktc}^{A}}{p_{jktc}^{O}q_{jktc}^{O}}$ is the value of imports by air transportation relative to ocean shipments to the US from exporter *j*, product *k*, at time *t* and coast *c* (west or east coast of the US); $ln\left(\frac{p_{jktc}^{A}}{p_{jktc}^{O}}\right)$ is the value per kilo of imports by air relative to ocean cargos; $ln\left(\frac{f_{jktc}^{A}}{f_{jktc}^{O}}\right)$ is the ad-valorem air freight charge relative to ocean shipments; $\left(days_{jc}^{O}-1\right)$ is the international transportation delays; σ is price elasticity; $\sigma\tau$ is the effect of international transportation delays on the choice of transportation mode and, τ is the consumers' preference for timely delivery.

Products are grouped by End-Use 5-digit industry category and the equation is estimated separately for each of those industries. The authors take advantage of product variation to estimate time sensitivity τ using exporter and HS6 fixed effects.[52] τ is interpreted as the average increase in the probability that an industry will be air shipped due to the valuation of timeliness in that industry, other things equal. Results for 110 industries estimations are shown in Figure 3.1. The End-Use 5-digit categories selected

[52] τ is calculated for each industry by taking the ratio ($\sigma\tau$ / σ).

for the estimation correspond to industries grouping 100 or more different products at the HS10 classification level. 116 industries passed this selection criterion. From those 116 industries, 70 gave statistically significant coefficients for time cost (highlighted with black solid lines in Figure 3.1).[53]

Trade data is from the U.S. Census Bureau. I use U.S. merchandise imports from 121 countries in 1991 and 2006 at the HS 10-digit level and then I aggregate over End-Use 5-digit categories in line with the time sensitivity level of aggregation. Trade data is deflated using the Imports Price Index by End-Use categories reported by the U.S. Bureau of Labour Statistics. To calculate the growth of imports between 1991 and 2006 consistently at the industry level the data provided by the U.S. Census Bureau needs to be adjusted to changes in product classifications that are introduced over time. These changes in classification take different forms. Some changes occur when products become obsolete and disappear or when new products are introduced. These modifications, where real changes in products occur, are referred to as extensive margin changes in codes (Pierce and Schott 2010). Other modifications are observed when the classification changes for surviving products. For example, some codes are swapped for new ones while others are grouped into one or split into more codes between periods. These changes in surviving products, in which I focus in this study, refer to an intensive margin modification in the classification system. Calculating the change in imports by industry consistently over time then requires an adjustment of the data by a concordance classification that makes the product codes comparable across periods. To make these classifications consistent Pierce and Schott (2010) create a unique identification number to each code, which stays unchanged over time. As a result, all changes in classification are

[53] Out of the 36 estimations with statistically insignificant results the histogram omits point estimates lying 2 standard deviations from the mean.

traceable from one period to another, allowing the calculation of the intensive margins import growth to be consistent over time.

After linking the trade data at the HS 10-digit level in 1991 with the corresponding 2006 data using the concordance mentioned above I drop all the products that are unique to 1991 or 2006. This will keep only those products that survived between these two periods, allowing a precise calculation of the intensive margins growth. Then, I group the HS 10-digit categories by their correspondent End-Use 5-digit classification level to bring the trade data to the level at which the time sensitivity indicator was estimated.[54]

Distance is from the *Centre d'Etudes prospectives et d'Info. Internationales* (CEPII). I use the geodesic distances calculated following the great circle formula, which uses latitudes and longitudes of the most important cities/agglomerations in terms of population).[55]

3.5. **Results**

The agglomeration effect of time sensitivity

In Table 3.1 I report the results of estimating equation (1), where the time sensitivity indicator from Hummels and Schaur (2013) is interacted with the geographical proximity between the U.S. and its exporters. Columns 1 to 3 show exploratory regression results implementing different combinations of

[54] I use the HS – End-Use concordance for 2006. About 10% of the unique codes created by Pierce and Schott to identify changes in classification over time are divided into more than one End-Use 5-digit category. To keep the time sensitivity indicator consistent at the End-Use 5-digit industry level I drop these conflicting observations from the dataset.

[55] The definition of distance is from Mayer, Thierry and Zignago, Soledad (2011): Notes on CEPII's distances measures: the GeoDist database. Published in: CEPII Working Paper No. 2011-25

industry and exporter fixed effects, while columns 4 and 5 correspond to results using the full set of fixed effects. The proximity-TS coefficients do not vary significantly across the estimations reported in columns 1 to 3, showing that the formulation of equation (1) is not particularly sensitive to the introduction of either industry or exporter fixed effects. In column 4, where both sets of fixed effects are implemented, the model explains 45.9% of the variation in the dependent variable and the results are consistent with the previous specifications. The proximity-TS coefficient is positive and statistically significant at the 5% significance level.

This result shows that, between 1991 and 2006, the growth in U.S. imports of time sensitive products was faster from countries relatively closer to the U.S., providing statistical evidence suggesting that the negative effect of distance on trade in time sensitive industries is strengthening over time, producing an agglomeration effect towards the demand centre. One possible explanation to this result may be linked to the rise of new managerial practices such as lean retailing and just-in-time operations that may have increased the demand for timeliness during the last decades. These business practices, together with new communication and information technologies that sped up some of the stages in the supply chain may have raised, rather than reduced the marginal cost of distance on time sensitive trade, as suggested by Venables (2001) and in spite of the decreasing cost of international transportation speed during the last decades.

One potential concern may arise from the fact that a significant proportion of U.S. imports come from its closest neighbours, Mexico and Canada. These two countries share unique characteristics in their commercial relationship with the U.S. They are significantly closer in comparison to other important trading partner and they are the only ones who share a land border with the U.S. making it possible to trade by land. In addition, they are the only other two members of the North American Free Trade Agreement (NAFTA). In 2006, for example, almost 28% of U.S. imports came from

Mexico and Canada. This impressive share of total U.S. imports enjoyed by these two countries alone may be possibly tilting the results reported in column 4 of table 3.1, making them not applicable to a more general analysis. To eliminate this possibility, in column 5 I report estimation results excluding Mexico and Canada. The β coefficient shows a negligible change in magnitude and stays statistically significant at the 5% significance level.[56]

Results reported in table 3.1 are based on a time sensitivity indicator that consists of a ranking of industries ordered according to their sensitivity to delays. This implies that the proximity-TS estimation coefficient will be strictly increasing on the time sensitivity indicator. However, it is also possible that the agglomeration effect only occurs above a certain threshold of sensitivity to delays, without significant changes in the effect across industries above or below the threshold. To test whether the agglomeration effect reported in table 3.1 varies with changes in the measurement of time sensitivity I also estimate equation (1) using categorical dummy variables that separate the data into different groups according to the level of industry time sensitivity. First I create a categorical variable TS^M to separate the data by a threshold defined at the mean of the time sensitivity indicator as follows:

$$TS^M = 1 \quad if\ TS \geq \overline{TS}$$
$$TS^M = 0 \quad otherwise$$

Where $\overline{TS}$ is the mean of the time sensitivity indicator.

[56] As a robustness test I also estimate equation (1) where the imports growth include the extensive margin change between 1991 and 2006. The extensive margin change in U.S. imports at the End-Use 5-digit level accounts for the discontinuation of old products and the introduction of new ones in each industry aggregate. The estimation results, which are almost identical to those reported in Table 3.1, are presented in the Appendix (Table A1).

In addition, I estimate the agglomeration effect at opposite extremes of time sensitivity by creating two categorical variables TS^T and TS^B, which correspond to the top and bottom 25% of industries, respectively:

$$TS^T = 1 \quad if\ TS \geq TS^{75}$$
$$TS^T = 0 \quad otherwise$$

Where TS^{75} represents the 75th percentile of the time sensitivity indicator and,

$$TS^B = 1 \quad if\ TS \leq TS^{25}$$
$$TS^B = 0 \quad otherwise$$

Where TS^{25} represents the 25th percentile of the time sensitivity indicator.

Table 3.2 reports the estimation results of equation (1) with the full set of fixed effects and the interaction term proximity-TS using the categorical measurements of time sensitivity previously described (TS^M, $TS^T$and TS^B). Column 1 corresponds to the estimation of proximity-TS^M including all exporters to the U.S. while column 2 excludes Mexico and Canada. The results show that the interaction term coefficients in these two specifications, although smaller in magnitude, maintain the sign and statistical significance reported in the comparable columns 4 and 5 of table 3.1. Columns 3 and 4 of Table 3.2 show the results of estimating the interaction using the industries with a time sensitivity above the 75th percentile (proximity-TS^T), including all exporters and excluding Mexico and Canada, respectively. As expected, the coefficients on proximity-TS^T are larger than the coefficients on proximity-TS^M reported in columns 1 and 2, suggesting a stronger agglomeration effect at higher levels of time sensitivity. Columns 5 and 6 provide supporting evidence to these findings, where as in the previous cases and for consistency, results reported in columns 5 and 6 include all exporters and exclude Mexico and Canada, respectively. Considering industries with time sensitivity below the 25th percentile (proximity-TS^B) the coefficients switch signs from positive to negative. These results suggest that U.S. imports in industries that are not very sensitive to delays have grown faster, between 1991 and 2006, from countries located further away relative to nearby countries.[57]

Relative growth of trade in time sensitive industries

Figure 3.2 reports the relationship between imports growth and time sensitivity between 1991 and 2006. The vertical axis shows the import growth for each End-Use 5-digit classification category while the horizontal axis is the corresponding time sensitivity level. Higher time sensitivity is associated with higher growth in trade. The red line represents the fitted values of the simple regression of the growth in imports on time sensitivity. The estimated slope of the line is 0.534 and statistically significant at the 1% significance level.[58]

The estimation depicted in figure 3.2 implies that the growth in imports between 1991 and 2006 is strictly increasing in time sensitivity. In figure 3.3 I classify the data into two different categories to distinguish between high and low time sensitive industries. The threshold used to separate the two categories is defined as the mean value of time sensitivity $\overline{TS}$. High time

[57] As an additional robustness test I estimate the regressions reported in Tables 3.1 and 3.2 excluding China. The results show no qualitative change in any of the formulations.

[58] To eliminate potential outliers this estimation and Figure 3.2 exclude observations above the 95th percentile and below the 5th percentile of the imports change between 1991 and 2006. When these observations are not excluded the coefficient is 0.714 at the 1% significance level.

sensitive industries TS^H are those with a time sensitivity coefficient equal or greater than $\overline{TS}$.

Figure 3.3 shows the share of TS^H in total U.S. imports in 1991 and 2006. In 1991 TS^H represented 37% of total U.S. imports while in 2006 that share increased significantly to 54%.

These results suggest that between 1991 and 2006, trade in industries that are most sensitive to delays grew faster than less sensitive ones, possibly because of the introduction of new communication and transportation technologies that facilitated the internationalisation of the demand for time sensitive goods, as proposed by Hummels and Schaur (2013). On the one hand, communication technologies may have helped coordinate and synchronize both production and commercialisation processes across country borders without significantly compromising speed in the supply chain. On the other, transportation technologies may have reduced the marginal cost of speed in international transportation by, for example, making air shipments cheaper.

The relative growth of trade in time sensitive industries is particularly important because of its implications on the debate about the death of distance. Over time, as shown in the previous section, the negative effect of distance on time sensitive trade is strengthening, producing an agglomeration effect towards the demand centre. However, the impact of this agglomeration force on the overall effect of distance on trade, as estimated by the standard gravity model, will depend on the relative participation of time sensitive industries in total trade. The increasing share of time sensitive industries in total trade in combination with the agglomeration effect reported in the previous section may explain, at least in part, why the distance effect on trade has not been weakening over time. In addition and possibly more interestingly, these results may also offer a potential explanation as to why some studies have found that the distance effect has rather strengthen over time (see for example Berthelon and Freund 2008).

Specialisation in time sensitive industries

The impact of time sensitivity on the patterns of international trade may not be limited to a geographical agglomeration effect. Independently of their geographical location some countries may have a comparative advantage in the production of time sensitive products. Hence, the relative growth of trade in time sensitive industries reported in the previous section may not be benefiting all countries equally. Previous studies suggest that developed countries have a comparative advantage and as a consequence, specialise in industries that are more sensitive to delays. This may imply that they are better positioned to benefit from the increasing demand for timeliness and the relative growth in international trade in time sensitive industries observed during the last decades. In this section I discuss the results of estimating whether more developed countries have specialised in time sensitive industries relative to developing nations and whether this pattern has strengthened or weakened over time.

Table 3.3 reports the estimation results of the relationship between the specialisation coefficient described in an earlier section and cross-country level of economic development for 1991 and 2006 separately. These figures are detailed in the top and middle panels of Table 3.3 respectively. Columns 2 and 3 present the results using GDP per capita (GDPC) as a measurement of country development while columns 4 and 5 show the results using OECD membership. In the bottom section of the table I also present the results of the relationship between country level of development and the change in the specialisation coefficient between 1991 and 2006. Column 1 shows simple correlation coefficients while columns 2 to 5 describe the results of regressing the specialisation indicator on country development using OLS.

There is statistical evidence showing a positive relationship between the specialisation coefficient and cross-country level of development in 1991.

The estimation coefficients on GDPC reported in columns 2 and 3 (not controlling and controlling for proximity respectively) are positive and statistically significant at the 5% significance level. However, the size of the coefficients is relatively small. A 10% higher GDPC is associated with a 0.74% higher share in time sensitive industries in total exports to the U.S (column 3). The coefficients are larger in the case of OECD membership, but they are barely statistically significant (columns 4 and 5).

Interestingly, a clearer pattern of specialisation emerges in 2006. Consider first the formulation using GDPC. The positive correlation for 2006 between the level of specialisation and GDPC (panel 2 column 1) is double the size of the correlation value for 1991. Then, the regression result after controlling for proximity reported in panel 2 column 3 shows that the coefficient on GDPC for 2006 is almost three times its size than in 1991 and statistically significant at the 1% significance level. The result of estimating equation (3) in 2006 implies that a 10% higher GDPC is associated to a 1.85% higher share of time sensitive products in total country exports to the U.S. From columns 4 and 5, it can be observed that these results are confirmed when OECD membership is used as a measurement of country development. On average and independently of their proximity to the demand centre, more developed countries tend to specialise in the production of time sensitive products. In addition, this pattern of specialisation seems to be strengthening over time.

The bottom section of table 3.3 shows the estimation result of equation (4) below, a variation of equation (3) where the dependent variable is the change in the specialisation coefficient between 1991 and 2006. Figure 3.4 illustrates this result.

$$\Delta\left(\frac{X^{TS}}{X}\right)_c = \propto + \beta(Development)_c + \gamma(Proximity)_c + \varepsilon \qquad (4)$$

The growth in the share of time sensitive products in total exports between 1991 and 2006 has been relatively higher in developed countries, which has given rise to a pattern of trade where developed countries specialise in time sensitive industries as shown in table 3.3 and conjectured by Deardorff (2002) and Venables (2001). This change in the pattern of specialisation may be explained by the increasing demand for timeliness produced, for example, by the introduction of managerial practices such as lean retailing and just-in-time production chains, where developed countries seem to enjoy a comparative advantage.

These results, in conjunction with the relative growth of trade in time sensitive industries may contribute to our understanding of the capacity of different countries to improve their participation in the global market. Not all countries equally benefit from the relative growth of trade in time sensitive industries. The estimation results reported in this section suggest that developed countries are better positioned to take advantage of the increasing demand for timeliness and the growing trade in time sensitive goods that has been observed during the last decades.

3.6. **Conclusion**

Time represents a cost in trade, but the extent to which time constitutes an impediment to trade varies considerably across products and industries. Previous studies have taken different approaches to identify such time sensitivity variation in an effort to understand how time, as a cost, impacts on international trade. However, our knowledge of the effect of time on trade, and in particular on the patterns of trade is still limited. The main purpose of this study is to shed some light on this issue by first, assessing whether differences in time sensitivity are a determinant of geographical patterns of trade. And second, whether difference in time sensitivity impact on the patterns of trade specialisation across countries, independently of their geographical location in the world.

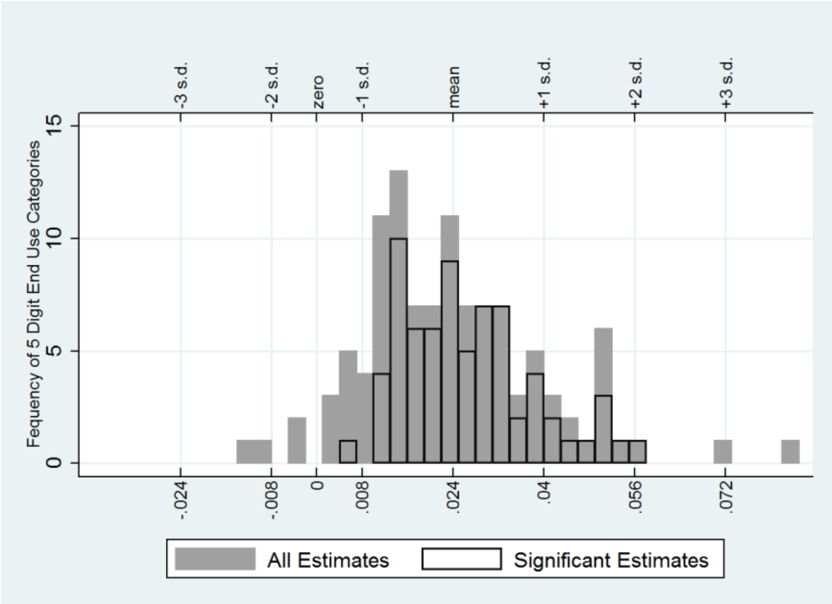
Using U.S. import data from 121 countries in 70 different industries this study is the first one to conduct a cross country/industry analysis of the impact of time sensitivity on the patterns of trade. My findings provide statistical evidence that the negative effect of distance on trade is strengthening over time, producing an agglomeration effect towards the demand centre. Between 1991 and 2006 the growth of U.S. imports in time sensitive industries was faster from countries located closer to the U.S. than countries located further away. This change in the geographical pattern of trade may be explained by a series of technological improvements which have increased the demand for timeliness during this period.

My results also show a relative growth of time sensitive industries in total trade. The internationalisation of the demand for time sensitive goods may have been facilitated by improvements in information, communication and transportation technologies during the last decades. New information and communication technologies improve the synchronisation and allow rapid adjustments to changes in demand and supply across different stages of international supply chains. In addition, new transportation technologies facilitate the international supply of time sensitive products by reducing the cost of transportation speed. These findings are relevant in the debate about the "death of distance" in international trade. A higher share of time sensitive industries in total trade, in conjunction with the strengthening agglomeration effect observed in time sensitive industries in the last decades may explain, at least in part, why the negative effect of distance on trade is not dying, and may be even strengthening over time.

Finally, time sensitivity may also impact on the patterns of trade specialisation across countries, independently of their geographical location. Previous studies suggest that developed countries possess a comparative advantage in time sensitive products. In this study I provide statistical evidence in support of this hypothesis. On average, high-income countries specialise in time sensitive industries. In addition, I show that between 1991 and 2006 this pattern of trade specialisation has strengthened, possibly because of an increase in the demand for timeliness during this period, for which high-income countries seem to enjoy a comparative advantage.

3.7. **Tables and Figures for Chapter 3**

FIGURE 3.1: DISTRIBUTION OF τ ESTIMATES AT THE END-USE 5-DIGIT CATEGORY



Source: Hummels and Schaur (2013)

TABLE 3.1 –AGGLOMERATION EFFECT OF TIME SENSITIVITY
OLS - (1991 – 2006)

Dependent Variable: U.S. imports change between 1991 and 2006 by exporter and End-Use 5-digit category					
	(1)	(2)	(3)	(4)	(5)
Proximity * TS	1.819**	1.767**	1.730***	1.622**	1.678**
	(0.82)	(0.81)	(0.64)	(0.64)	(0.66)
Constant	4.257***	-3.141**	2.106	-1.850	-1.549
	(0.08)	(1.49)	(6.41)	(6.62)	(6.62)
Industry FE	no	yes	no	yes	yes
Exporter FE	no	no	yes	yes	yes
Observations	5308	5,308	5,308	5,308	5,174
R^2	0.001	0.052	0.415	0.459	0.456

Notes: Standard errors are robust to the presence of arbitrary heteroskedasticity. Proximity*TS is mean centred. The Variance Inflation Factor (VIF) indicates that there is no multicollinearity in the Proximity*TS coefficient, with a value of 1.02 when all fixed effects are included (columns 4 and 5).
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

TABLE 3.2 – AGGLOMERATION EFFECT BY CATEGORICAL MEASUREMENTS OF TIME SENSITIVITY
OLS - (1991 – 2006)

Dependent Variable: U.S. imports change between 1991 and 2006 by exporter and End-Use 5-digit category						
	Time sensitivity $TS^M (dummy = 1\ if\ TS \geq \overline{TS})$		Time sensitivity $TS^T (dummy = 1\ if\ TS \geq 75^{th}\ percentile)$		Time sensitivity $TS^B (dummy = 1\ if\ TS \leq 25^{th}\ percentile)$	
	(1)	(2)	(3)	(4)	(5)	(6)
Proximity * TS	0.975**	1.033**	1.145**	1.136**	-1.455**	-1.549***
	(0.48)	(0.49)	(0.55)	(0.57)	(0.57)	(0.58)
Constant	-1.853	-1.563	-1.905	-1.599	-1.814	-1.520
	(6.62)	(6.61)	(6.61)	(6.61)	(6.62)	(6.61)
Industry FE	yes	yes	yes	yes	yes	yes
Exporter FE	yes	yes	yes	yes	yes	yes
Observations	5,308	5,174	5,308	5,174	5,308	5,174
R^2	0.458	0.456	0.458	0.456	0.458	0.456

Notes: Standard errors are robust to the presence of arbitrary heteroskedasticity. Proximity is mean centred. The Variance Inflation Factor (VIF) indicates that there is no multicollinearity in the Proximity*TS coefficient, with values below 2.05 in all estimations.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

FIGURE 3.2: IMPORTS GROWTH AND TIME SENSITIVITY (1991-2006)

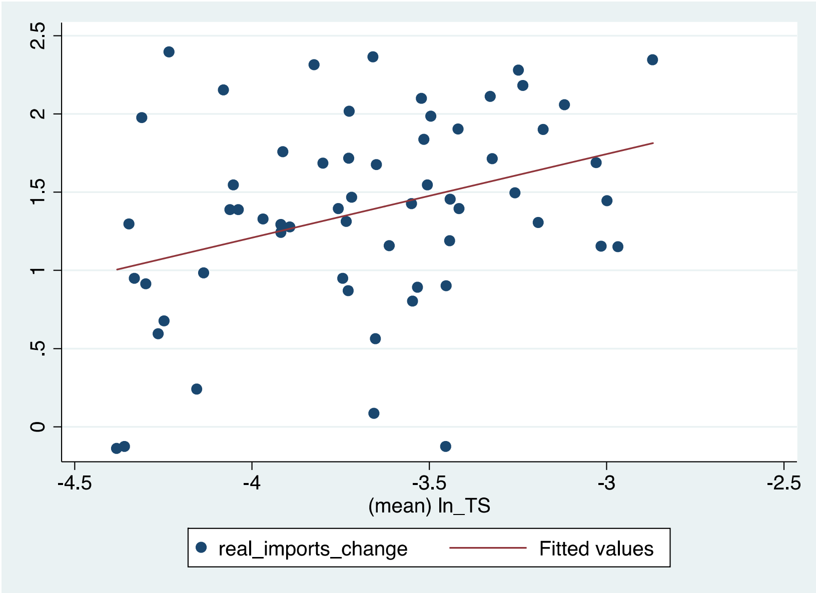


FIGURE 3.3: SHARE OF HIGH AND LOW TIME SENSITIVE INDUSTRIES IN TOTAL U.S. IMPORTS (1991-2006)

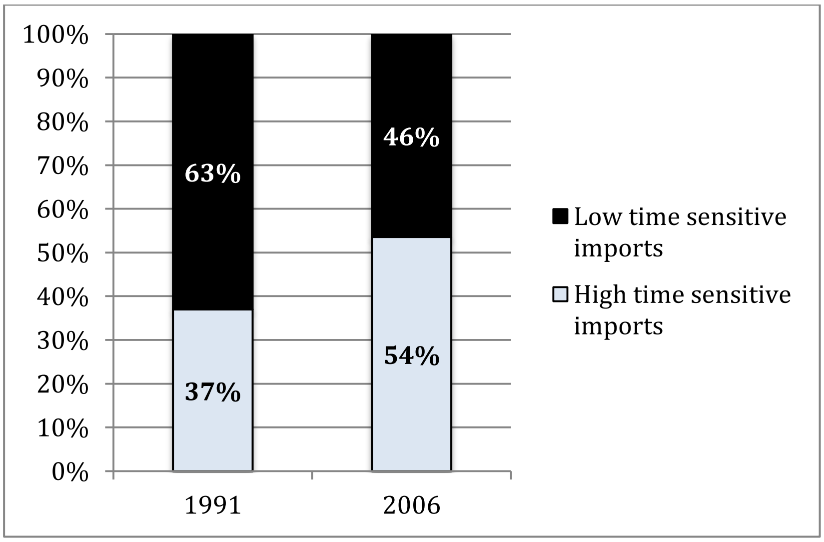
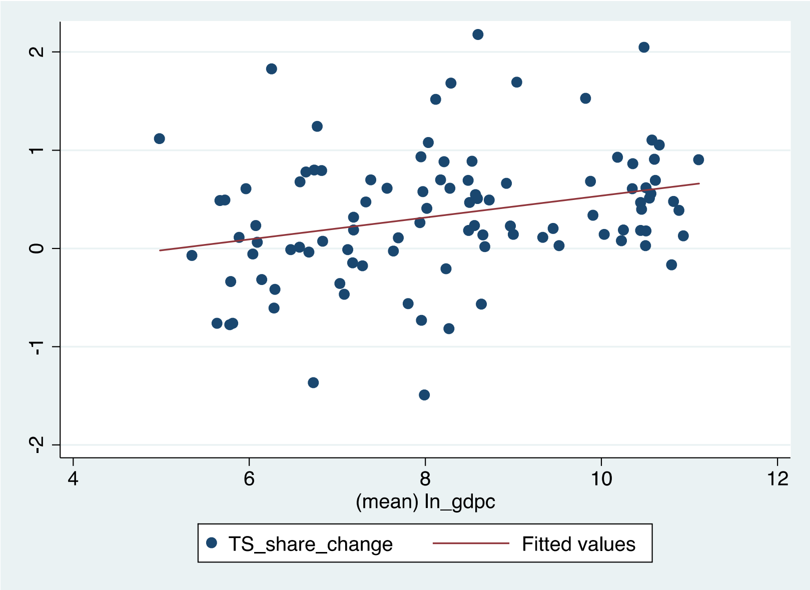


TABLE 3.3 – SPECIALISATION IN TIME SENSITIVE INDUSTRIES

	Correlation coefficient	OLS			
	(1)	(2)	(3)	(4)	(5)
Time sensitive export share (1991)					
GDP per capita	0.199	0.069**	0.074**		
		(0.03)	(0.03)		
OECD	0.151			0.191*	0.192*
				(0.10)	(0.10)
Proximity			0.228		0.084
			(0.20)		(0.21)
Constant		-2.358***	-0.369	-1.876***	-1.133
		(0.27)	(1.85)	(0.07)	(1.92)
Observations [a]	100	100	100	101	101
Time sensitive export share (2006)					
GDP per capita	0.343	0.175***	0.185***		
		(0.04)	(0.04)		
OECD	0.203			0.370***	0.381***
				(0.13)	(0.13)
Proximity			0.425		0.301
			(0.26)		(0.26)
Constant		-2.875***	0.798	-1.531***	1.118
		(0.32)	(2.26)	(0.09)	(2.33)
Observations	121	121	121	121	121
Change in time sensitive export share (1991-2006)					
GDP per capita	0.282	0.111***	0.112***		
		(0.04)	(0.04)		
OECD	0.179			0.261**	0.259**
				(0.12)	(0.12)
Proximity			0.017		-0.086
			(0.30)		(0.31)
Constant		-0.578*	-0.429	0.268***	-0.492
		(0.31)	(2.71)	(0.08)	(2.74)
Observations	101	101	101	101	101

Notes: Standard errors are robust to the presence of arbitrary heteroskedasticity. [a] One observation is missing due to unavailability of GDPC data for Santo Tome and Principe in 1991.
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

FIGURE 3.4: GROWTH IN COUNTRY SHARE OF TIME SENSITIVE EXPORTS TO THE U.S. BY GDPC (1991-2006)



3.8. **Appendix for Chapter 3**

TABLE A1 –AGGLOMERATION EFFECT OF TIME SENSITIVITY – EXTENSIVE MARGIN
OLS - (1991 – 2006)

Dependent Variable: U.S. imports change between 1991 and 2006 by exporter and End-Use 5-digit category					
	(1)	(2)	(3)	(4)	(5)
Proximity * TS	1.416*	1.436*	1.376**	1.358**	1.432**
	(0.79)	(0.79)	(0.63)	(0.62)	(0.64)
Constant	4.738***	1.604	10.080***	2.241	1.143
	(0.08)	(1.18)	(1.02)	(3.57)	(4.86)
Industry FE	no	yes	no	yes	yes
Exporter FE	no	no	yes	yes	yes
Observations	5,526	5,526	5,526	5,526	5,392
R^2	0.001	0.061	0.400	0.461	0.458

Notes: Standard errors are robust to the presence of arbitrary heteroskedasticity. Proximity*TS is mean centred. The Variance Inflation Factor (VIF) indicates that there is no multicollinearity in the Proximity*TS coefficient, with a value of 1.02 when all fixed effects are included (columns 4 and 5).
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Chapter 4: Summary and Concluding Remarks

The decreasing relevance of global tariffs during the last decades has shifted the attention of regional and international organisations towards the promotion of trade facilitation initiatives. Among these initiatives, actions to reduce export delays have been at the top in the list of priorities – this may possibly relate to recent economic research that finds export delays a major obstacle to trade. Export delays occur at every stage in the process of exporting a shipment of goods, from the moment the goods leave the production facility until they are loaded on a ship. Each of these export channels is also associated to monetary costs in the form of fees that are borne by exporters. Possibly because of a slightly longer history of data availability on delays, the role of export fees in the decision to trade has not received equal attention by economists. This is potentially problematic for two reasons. First, because export costs appear to be significant, particularly in developing countries. Second, because anecdotal evidence, in the form of countries' self-declarations, indicates that policies to reduce export delays may be costly and largely financed by increases in exporter fees.

In Chapter 1 we propose an analysis of how both domestic transaction costs to export, delays and monetary costs, impact on the decision to trade. Our objective is two-fold. First, we investigate the link between export delays and export monetary costs over time. Second, we disentangle the impact of export delays and export monetary costs on the decision to trade by estimating their combined effect using a gravity model. Our results provide statistical evidence in support of the notion that there is an endogenous link between export costs and export delays. On average, as indeed suggested by countries' self-declarations, reducing export delays increases export costs. In addition, in the case of developing countries we find that export delays play a secondary role to export costs in trade decisions. Thus, policies implemented to facilitate trade by reducing export delays may result in a sub-optimal outcome and may even be self-defeating.

It is unclear why governments fund delay reductions with export cost hikes instead of increasing taxes to the general public. To shed relevant light, in Chapter 2 we offer one theoretical model which provides a possible explanation. Our model shows that governments may reduce export delays by increasing export monetary costs in order to maximise social welfare. This is achieved through three different channels. First, passing the cost of reductions in export delays to exporters increases the terms-of-trade of the country; second, it increases the resources that are allocated to production; and third, it generates a national productivity gain, as only more productive firms will choose to export. These results imply that policies oriented towards facilitating trade through reductions in delays should also take into consideration the increment of pecuniary costs that impede trade.

Finally, Chapter 3 investigates how the variation in sensitivity to export delays across industries impact on the patterns of trade. Using U.S. import data from 121 countries in 70 different industries between 1991 and 2006 my findings are three-fold. First, my estimation results show that the negative effect of distance on time sensitive trade is strengthening over time, producing an exports agglomeration effect towards the demand centre. During the period considered, exports in time sensitive industries grew faster from countries located closer to the U.S. than countries located further away, which may be explained by the increase in the demand for timeliness generated by the rise of new managerial practices, such as just-in-time operations and lean retailing, as well as by the improvement in communication and information technologies observed in the last decades. Second, my results also show a relative growth of time sensitive industries in total trade. A higher share of time sensitive industries in total trade, coupled with the strengthening agglomeration effect produced by time sensitivity may provide a possible explanation to why, in spite of the recent introduction of new transportation and communication technologies, the negative effect of distance on trade is not decreasing or may be even increasing over time as measured in typical gravity specifications. Third, I provide statistical evidence suggesting that, independently of their geographical location, time sensitivity also impacts on the patterns of trade specialisation across countries. My findings show that high-income countries not only specialise in industries that are more sensitive to delays, but also that this pattern of specialisation is consolidating over time.

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