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TIME TO SHIP DURING FINANCIAL CRISES

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ABSTRACT

Time to ship during financial crises*

We show that the negative impact of financial crises on trade is magnified for destinations with longer time-to-ship. A simple model where exporters react to an increase in the probability of default of importers by increasing their export price and decreasing their export volumes to destinations in crisis is consistent with this empirical finding. For longer shipping time, those effects are indeed magnified as the probability of default increases as time passes. Some exporters also decide to stop exporting to the crisis destination, the more so the longer time-to-ship. Using aggregate data from 1950 to 2009, we find that this magnification effect is robust to alternative specifications, samples and inclusion of additional controls, including distance. The firm level predictions are also broadly consistent with French exporter data from 1995 to 2005.

JEL Classification: F10, G01 and G32
Keywords: financial crises, international trade and time-to-ship

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1 Introduction

This paper documents a robust stylized fact: the fall in trade caused by financial crises is magnified by the time-to-ship goods between the origin and the destination country. The paper is motivated by the collapse of world trade that occurred during the financial crisis of 2008-2009 and the debates on why it was much larger than the fall in world GDP and demand. But we go further by analyzing the effect of financial crises on trade using historical data. The amplification effect of time-to-ship is very robust. It is observed at the bilateral level on a large panel of countries over the period 1950-2009 and at the firm-level over the period 1995-2005. We argue that this stylized fact of financial crises strongly suggests that they affect trade not only because they impact demand but also through financial frictions which are specific to international trade.

International trade differs from intranational trade in several dimensions. One on which we focus in this paper and which we can interpret as a financial friction is time-to-ship[1]. It takes time to transport goods internationally and we focus on how this financial friction is exacerbated during a financial crisis. For instance, a shipment takes more than 28 days to go from Rotterdam to Hong-Kong but a bit more than 1 day from Rotterdam to Copenhagen. This is without taking into account the time to load and unload the boat and the time taken by customs and other administrative procedures. Djankov, Freund, and Pham (2006) found in a sample of 180 countries that the median amount of time it takes from the moment the goods are ready to ship from the factory until the goods are loaded on a ship is 21 days. In "normal" circumstances, time to load, ship... implies a transport cost which depends on distance, the value and the weight of the good transported. Of course even in normal times, there is an opportunity cost to time which can be measured broadly by the cost of capital. However, during a financial crisis time-to-ship takes a new dimension: as time passes during which goods are stuck on cargo the probability that a financial incident takes place in the destination country rises. We model this incident as the possibility that during a financial crisis the importer defaults on her payment obligation. We present a simple partial equilibrium model in which heterogeneous exporters sell to distant importers. We show that

[1] We are not the first to analyze the implications of this characteristic of international trade (see for example Amiti and Weinstein (2011) and Feyrer (2011) for the most recent contributions).

in such a framework the negative impact on trade of the increased probability of default that comes with a financial crisis is amplified by the time it takes to ship the good. Crucially, time to ship does not in this case simply represent an extra cost, like transport costs do, it increases the elasticity of export volume to the expected cost of default. This is the core of the magnification effect that time to ship produces. The reason is that exporters react to this increased probability of default by raising their export price and reducing their export volumes and values, the more so the longer the time of shipping. This can be thought as a pricing to market strategy that depends on financial conditions in the destination country. Hence, on the intensive margin, the value of imports by existing importers falls with a financial crisis and this is more so the longer the time to trade with the exporter country. We also show that in such a framework, the probability to exit and cease exporting is higher in a country that experiences a financial crisis and that this effect is again amplified by time-to-ship.

We test these firm-level predictions on firm-destination specific export data obtained from the French customs over the period 1995-2005. The firm-level data, in addition to the aggregate data, is consistent with predictions of the model and the role of time-to-ship. We find that French exporters indeed raise their price and decrease their export volumes when the destination country is hit by a crisis. The reduction in volume and value is larger when time-to-ship is longer. Similarly, the probability that an exporter exits a given destination increases when the destination incurs a financial crisis, the more so when time-to-ship is longer. Using aggregate data from 1950 to 2009, we find that this magnification effect is robust to alternative specifications, samples and inclusion of additional controls, including distance. Both in firm level and aggregate regressions, when we include both the time-to-ship variable and distance, only the effect of time-to-ship remains significant. This suggests that the mechanism that we uncover is indeed due to the role of time as a financial friction.

There is a now large and still growing literature on the analysis of the trade collapse during the recent financial crisis. Some papers have analyzed the characteristics of countries and sectors that were most hit by the financial crisis. This is the case of Chor and Manova (2012) who analyze the effect that credit conditions had on international trade during the recent global crisis by examining the evolution of monthly US imports over the November 2006 to October 2009 period, and compare trade patterns before and during the crisis. They identify the impact of credit conditions by exploiting the variation in the cost of external capital across countries and over time, as well as the variation in financial vulnerability across sectors. They find that during the crisis period, countries with tighter credit availability exported less to the US, relative to other countries. Another related paper on the effect of credit constraints on export performance at the firm level is Amiti and Weinstein (2011) who show that Japanese banks transmitted financial shocks to exporters during the systemic crisis in Japan in the 1990s. Ahn, Amiti, and Weinstein (2011) review evidence that financial factors may have resulted in a greater decline in exports than were predicted in models without financial frictions. They show that export prices rose relative to domestic manufacturing prices across a large number of countries. This is consistent with a result we find in a very different data set which is that export prices rise when the destination country experiences a financial crisis. They also find that import and export prices of goods shipped by sea, which are likely to be affected most by trade finance contractions, rose disproportionately more than those shipped by air or land. Our paper is complementary to theirs in pushing the argument that what we document in this paper resemble footprints left by financial friction shocks during a financial crisis. In the same vein, Bricongne *et al.* (2012) find that the exports of French firms in more external finance-dependent sectors were more adversely hit during the recent global crisis. However, some economists have downplayed the role of trade frictions and trade finance when explaining the drop in international trade. Levchenko *et al.* (2010) emphasize the disruption of global production lines and the reduction in trade in intermediate goods during the recent financial crisis to explain that the fall in trade has been larger than the fall of output and therefore conclude that trade finance has played a minor role in the trade collapse of 2008-2009.[2] Eaton *et al.* (2011) quantify the relative contributions of changes in demand versus changes in trade frictions, using a general equilibrium model of production and trade. They also conclude that the fall in demand was more important.

[2]Interestingly, in another paper, Levchenko *et al.* (2011) find results that are very much related to ours on the role of shipping time on US trade data during the 2008-2009 financial crisis. They find that the fall of US imports (but not exports) during the financial crisis period (Q2-2008 to Q2-2009) was larger with countries with longer time-to-ship. They also find that sectors with higher shares of imports shipped by ocean (relative to air shipping) experienced larger drops.

Finally, we are not the first to focus on time-to-ship to better understand trade patterns during financial crises. In addition to Levchenko *et al.* (2010) already cited, Alessandria *et al.* (2010), Ahn (2011), Schmidt-Eisenlohr (2011), Leibovici and Waugh (2010), Kim and Shin (2012) present models with time-to-ship frictions. The first shows that this introduction generates inventory adjustments that can explain the trade collapse during the latest financial crisis. The mechanism we focus on which generates testable implications at both the aggregate and firm levels is however different as it does not rely on inventories. Schmidt-Eisenlohr (2011) and Antras and Foley (2011) present rich models with time-to-ship that endogenizes the choice of trade financing in a situation where default risks exist both for exporters and importers.

The paper is organized as follows. We present, in the next section, a simple model of international trade with possible importer default, and we derive implications of the role of time-to-ship during financial crises, at the firm and at the aggregate level. In section 3, using aggregate data on bilateral trade on the period 1950-2009, we show that that the negative impact of a financial crisis on trade is magnified by time-to-ship between the two countries. Finally, in section 4, using French exporter-level data we test the firm-level implications of the model. Section 5 concludes.

2 Model

We present a simple model where a financial crisis generates a fall in imports which is more pronounced for country pairs with a longer shipping time. The aim of the model is to provide guidance for our empirical work and generate simple testable implications at the aggregate and at the firm levels. The model is in partial equilibrium and the financial crisis is considered as an exogenous event. We leave for future research the aim of analyzing these issues in a general equilibrium framework. We focus on exporters in the Home country who export to many countries, each of them characterized by the number of periods s it takes to ship a good to the Home country.[3] Exporters differ in terms of productivity φ as in Melitz

[3] For a general equilibrium model of time-to-ship that analyzes how the variation in the rate at which agents are willing to substitute across time affects how trade volumes respond to changes in income and

(2003).

The model features a financial friction in the form of an exogenous probability of default per period which depends on the state of the economy. Each period, the probability that an importer of country s encounters a financial difficulty and defaults on his payments is q_s. If the importer defaults, we assume for simplicity that the exporter is not paid for the goods she has shipped and loses the value of the shipment[4]. The probability that the payment due is effectively paid is therefore $(1-q_s)^s$. The probability that a default occurs during the shipping period increases with the length of shipping.

The probability q_s, which characterizes the financial health of country s, is assumed to be higher during a financial crisis.[5] Exporters are risk neutral firms in monopolistic competition markets and face a price elasticity of demand of σ in the markets they export to. They only use labor in production and have heterogeneous labor productivity φ. We can think of importers as wholesalers who then sell to consumers with Dixit-Stiglitz type of utility with love for variety. In this case, σ is the elasticity of substitution between varieties in the utility function of consumers. The exporter is paid when the goods are delivered. Hence, we do not take into account the possibility that the (risk neutral) exporter can buy insurance through trade finance and bank intermediation and we assume she uses open account terms. Importers can—but will not always choose to[6]—use letters of credit issued by their banks (the issuing bank) as a means of assuring exporters that they will be paid. If the exporter submits the required documentation (invoices, bills of lading, etc.) to its bank (the advising or confirming bank), payment is made to the exporter. Letters of credit are however expensive and require both confidence and liquidity to provide finance and insurance about

prices, see Leibovici and Waugh (2011).

[4]In reality, the penalty may not be as harsh except of course in the case of perishable goods. If the goods can be shipped back from destination the cost of the financial incident will be lower but our main conclusions will remain qualitatively similar.

[5]Some heterogeneity on the dimension of the importers, in particular on their financial health, could be added but this would not change the results fundamentally.

[6]Antras and Foley (2011) use a detailed transaction level data from a U.S. based exporter of frozen and refrigerated food products, primarily poultry, to describe broad patterns about the use of alternative financing terms. The most commonly used financing terms do not involve direct financial intermediation by banks. They are cash in advance terms and open account terms; these are used for 44.0% and 39.2% of the value of transactions, respectively. Cash in advance terms require the importer to pay before goods are shipped. Open account terms allow a customer to pay a certain amount of time following receipt of the goods

payment to the exporter. The confirming bank may lack confidence in the issuing bank. Ronci (2004) indeed reports sharp falls of trade finance during the most important emerging markets financial crises of the 1990s. During the 2008-2009 financial crisis, the collapse of trade finance was also blamed for part of the trade collapse. Auboin (2009) reports an increase in 2008 in spreads on 90 days letters of credit from 10-16 basis points in normal times to 250-500 basis points for letters issued by certain "risky" countries. A study by the IMF (2009) that surveyed several banks in developed and emerging markets reported a sharp increase in the cost of trade finance: 70% of the banks reported that the price for letters of credit had risen. In our model, if the cost of trade finance was to increase with the probability of default and a financial crisis, our qualitative results would be similar: higher cost of trade finance during financial crises would rise exponentially with the time-to-ship the goods and would translate in higher marginal costs and prices in the same manner as in the present model. A much richer model that endogeneizes the financing mode of international trade as a function of default of both importers and exporters is provided by Schmidt-Eisenlohr (2011) and Antras and Foley (2011) but this extension is beyond the scope of this paper. The exporter's problem is therefore to maximize the present value of profits of exporting to country s:

$$V_s(\varphi) = \frac{p_s(\varphi)\tau_s x_s(\varphi)}{(1+r)^s}(1-q_s)^s - \frac{w}{\varphi}\tau_s x_s(\varphi) - F, \tag{1}$$

where the first term is the value of sales discounted by the per period interest rate r and the probability of default of the importer. w is the wage rate and w/φ the marginal cost of production. F is a fixed cost to export. These costs have to be paid before the export takes place. Profit maximization generates the following optimal price and export quantities:

$$p_s(\varphi) = \frac{\sigma}{\sigma-1}\frac{w}{\varphi}\left(\frac{1+r}{1-q_s}\right)^s, \tag{2}$$

$$x_s(\varphi) = Y_s P_s^{\sigma-1}\left[\tau_s p_s(\varphi)\right]^{-\sigma} = Y_s P_s^{\sigma-1}\left[\frac{\sigma}{\sigma-1}\frac{w\tau_s}{\varphi}\left(\frac{1+r}{1-q_s}\right)^s\right]^{-\sigma}, \tag{3}$$

where Y_s and P_s are respectively the income of the country and the standard welfare-based price index that depends on prices of all locally produced and imported varieties. The first two elements of the price equation (2) are the standard markup and marginal cost of the firm. The third element is specific to our setup and depends on time-to-ship. Because the probability of default increases with shipping time, the exporter will react by increasing its price and decreasing its export quantity for importers at longer shipping times. This is also the case because the opportunity cost of funds increases with shipping times and the interest rate. The later represents the cost of borrowing, which can rise abruptly for firms during a financial crisis. This specific prediction of the model (exporters charge higher export prices to destinations with higher shipping time) can be related to other models and empirical results (see Manova and Zhang, 2012 or Martin, 2010) who have found a similar result but with a different mechanism (additive transport costs for example). Note that if importers differed by their financial situation so that each importer had a different probability of default in a given country, the exporter would discriminate against less "trusted" importers (importers with lower capital, assets with lower value, a more vulnerable balance sheet...) by a higher price and a lower exported quantity. This is what Antras and Foley (2011) find in a recent study on poultry exports. Note also, that the reduction of trade, which comes from the decision of exporters to raise their price, comes on top of the standard demand effect (income Y_s in the crisis country falls) and the possible effect on the price index P_s which could come for example with a sharp real depreciation.

A notable implication of our framework is that during financial crises, firm-level export prices should increase whereas firm-level export volumes and values should fall: exporters discriminate against destinations hit by a financial crisis because the expected marginal revenue falls in such destinations. This can be thought as a pricing-to-market strategy that depends on financial conditions in the destination country. Both effects on prices and volumes should be magnified by longer shipping time s.[7] Crucially, time is by nature different from transaction costs such as transport costs (iceberg costs τ_s in our framework) or asymmetric information. Time to ship does not simply reduce the expected revenues of trading overseas, it increases the elasticity of this expected loss to financial risk.

$$\frac{\partial p_s(\varphi)}{\partial q_s}\frac{q_s}{p_s(\varphi)} = \frac{sq_s}{1-q_s}, \tag{4}$$

[7]For simplicity, we investigate the effect a marginal increase in q_s, which may increase more sharply during a financial crisis.

$$\frac{\partial x_s(\varphi)}{\partial q_s}\frac{q_s}{x_s(\varphi)} = -\frac{s\sigma q_s}{1-q_s} \quad ; \quad \frac{\partial p_s(\varphi)\,x_s(\varphi)}{\partial q_s}\frac{q_s}{p_s(\varphi)\,x_s(\varphi)} = -\frac{s(\sigma-1)q_s}{1-q_s}. \tag{5}$$

Note that in these equations, the transport cost τ_s, does not appear and therefore plays no role in the magnification effect. Time to ship is, in interaction with financial risk, of different nature because it raises the elasticity of export volumes to change in financial risk. This will be important in the empirical section where we will want to distinguish between transport costs and time to ship. Note also that in the above equations, we do not take into account the impact that the financial crisis may have on export volumes through its effect on the price index and the income of the importing country. We will however be taking this effect into account when we go to the data. There is a threshold level of productivity φ below which the exporter will decide not to export, i.e., when V_s the present value of exporting to country s turns negative. We call this threshold for country s, φ_s^*. It can be shown that the effect of an increase in the probability of default on this threshold is given by:

$$\frac{\partial \varphi_s^*}{\partial q_s}\frac{q_s}{\varphi_s^*} = \frac{s\sigma}{\sigma-1}\frac{q_s}{1-q_s} > 0 \tag{6}$$

Hence, by raising the probability of default, a financial crisis pushes some lower productivity firms to exit. Again, this extensive margin effect is amplified by shipping time.

We are interested in analyzing the impact of a financial crisis that raises the overall probability of default of firms in the importer country, q_s. It can potentially also increase the interest rate r if the financial crisis (as in the case of 2008-2009) is a global crisis that raises the risk premium. Note that in our framework, the effect of an increase in the probability of default and of the interest rate have essentially the same qualitative impact.

The model also generates implications at the aggregate level. The value of the expected aggregate exports of the Home country to country s are given by:

$$X_s = \int_{\varphi_s^*}^{\infty} (1-q_s)^s\, p_s(\varphi)x_s(\varphi)dG(\varphi) = C_s Y_s P_s^{\sigma-1}\int_{\varphi_s^*}^{\infty} \varphi^{\sigma-1}\left(\frac{1-q_s}{1+r}\right)^{s\sigma} dG(\varphi) \tag{7}$$

where C_s is a constant. Given the impact of a rise in q, which we interpret as a financial crisis, the impact on exports to country s contains three terms:

$$\frac{\partial X_s}{\partial q_s}\frac{q_s}{X_s} = e_s + \frac{\partial Y_s}{\partial q_s}\frac{q_s}{Y_s} + (\sigma - 1)\frac{\partial P_s}{\partial q_s}\frac{q_s}{P_s}, \tag{8}$$

where the last two terms reflect the impact the crisis has on the income and the price index of the importer country. We assume that the net effect of these two last terms is negative. The first term e_s represents the impact of the financial crisis on aggregate trade once the income and the price effects have been controlled for.

Assuming a Pareto distribution for φ with k being the Pareto distribution parameter (an inverse measure of productivity heterogeneity) we obtain that:

$$e_s = -s\sigma\frac{q_s}{1-q_s} - \frac{s\sigma(k+1-\sigma)}{\sigma-1}\frac{q_s}{1-q_s} = -\frac{s\sigma k}{\sigma-1}\frac{q_s}{1-q_s}. \tag{9}$$

The first term in the first equation is the impact of an increase in the probability of default on the intensive margin of exports and the second one is the impact on the extensive margin of exports. Hence, the theory predicts that, as for the firm-level results, an increased probability of default negatively affects aggregate exports and that this negative impact is amplified by shipping time, through both the intensive and extensive margins.

Several predictions of our model can therefore been tested. At the aggregate level, the negative impact of a financial crisis on the imports of the country is amplified by time-to-ship from the source country. Note also that a financial crisis in the exporter country if it raises the cost of funding for the exporter has the same qualitative effect on trade as a financial crisis in the importer country: an increase in r has the same impact as an increase in q. In particular, the impact of such funding stress on trade should be amplified by time-to-ship.

There are also several predictions of our framework that can be tested using firm-level data. First, exporters raise their export price in countries hit by a financial crisis and this is more so the higher time-to-ship to the country affected by the financial crisis (equation 4). Both the volume and the value of the exports at the firm level should decrease when the destination country is hit by a financial crisis and this effect should be amplified by shipping time to destination (equation 5). Finally, when a country is hit by a financial crisis, the probability that some exporters cease to export to that country increases. Again, shipping time should amplify this increase in exit probability (equation 6). We now take these predictions to the data, starting with the aggregate implications.

3 Time-to-ship and the effect of crises on trade: country-level evidence

3.1 Empirical methodology

We first want to assess the effect of a banking crisis in a country on bilateral imports of this country, and how this effect varies with the time it takes to ship goods from each partner country. In this section we do this using aggregate trade data. A key issue is how to measure the time spent to trade goods internationally. A first possibility is to proxy this by geodesic bilateral distance. A second possibility is to use estimates of the time needed to ship goods. This is closer certainly to the mechanism we want to highlight. It is however not perfect as country pairs do not transport all goods by sea. Some goods are transported by road and others by air. We will try to deal with this issue. But, not surprisingly distance and time-to-ship are closely related and we will analyze how the results differ when we use either or both in the regressions. Our baseline estimation takes the form of a standard gravity equation:

$$\ln X_{ijt} = \alpha_1 \ln Y_{it} + \alpha_2 \ln Y_{jt} + \delta T_{ijt} + \gamma_1 BC_{jt} + \gamma_2 (BC_{jt} \times \ln \widetilde{d_{ij}}) + \mu_{ij} + \eta_t + \varepsilon_{ijt}, \quad (10)$$

where X_{ijt} represents exports from country i to country j at year t, Y is GDP, and T_{ijt} contains a set of time-varying bilateral controls, including FTA, currency union, and the real exchange rate. In most of the regressions, we include bilateral fixed effects μ_{ij}, so that time-invariant bilateral characteristics such as time-to-ship or geodesic distance, common language, contiguity or colonial links are captured (although this specification allows for interactions with the crises variable). BC_{jt} is a dummy variable that takes the value of 1 if the destination country j experienced a banking crisis during year t, and $\ln \widetilde{d_{ij}}$ is the log of bilateral time-to-ship between countries i and j (demeaned such that $\ln \widetilde{d_{ij}} = 0$ for the average value taken by time-to-ship in the sample). Finally, η_t represent year dummies and ε_{ijt} the error term.

Our coefficients of interest are γ_1 and γ_2. The first is expected to be negative: a banking crisis decreases imports (even after controlling for demand). We will see that γ_2 is also estimated to be negative: the negative effect of banking crises in the destination country is magnified by bilateral time-to-ship.

A difficulty when estimating this specification is that it omits the ideal price indexes (or multilateral resistance–MR–indexes, using Anderson and Van Wincoop, 2003 celebrated terminology). The inclusion of bilateral fixed effects μ_{ij} only partly solves the problem, as these MR indexes may vary over time, especially during financial crises. We will therefore check the robustness of our results to the inclusion of importer and exporter × year dummies. The inclusion of importer × year dummies controls for the importer price index that varies over time. It prevents from estimating γ_1, but our main coefficient of interest, γ_2, can still be identified.

Finally, in all estimations standard errors are robust to heteroscedasticity and clustered at the destination × year level.[8]

3.2 Data

The trade data come from the International Monetary Fund's Direction of Trade Statistics (DoTS).[9] It covers the 1950-2009 period, which is of crucial importance, since this includes the recent financial crisis, as well as past crisis episodes. While DoTS lacks data on trade for individual goods, it is the only data set containing a panel of worldwide bilateral trade that goes back far enough to offer a good match with the Reinhart and Rogoff (2011)'s data set on financial crises dates from 1800 to 2010. Our final data set includes 185 exporting countries and 69 importing countries from 1950 to 2009. Table 6 in Appendix A.1 lists the countries in our sample and indicates the countries covered in the Reinhart and Rogoff (2011)'s dataset. The lower number of importing countries is due to the availability of the financial crises data.

[8]Note that our results are robust to clustering at the country-pair level.

[9]See Head, Mayer and Ries (2010: Appendix A) for details on the compilation of trade flows from DoTS, and other gravity variables. We mostly rely on the same procedures here, with updated data.

Controlling for the occurrence of crises in the exporting country results in a significant loss of information, but leaves our results unchanged, as we will show later. For financial crises, we follow the literature and focus on banking crises (and check the robustness of our results with currency crises). According to Reinhart and Rogoff (2011: 1680), a banking crisis is marked by two types of events: "(1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; and (2) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions), that marks the start of a string of similar outcomes for other financial institutions." Reinhart and Rogoff (2011)'s data set combines various sources. Our final data set contains around a hundred of events, which include both, in their classification, severe and systemic banking crises. Appendix A.1 depicts other important characteristics of our data set: the frequency of country pairs with a banking crises in the destination country is plotted in Figure 1, the starting dates of the crises is shown in Table 7, and the mean differences in covariates with and without banking crises are reported in Table 9.

GDPs come from the World Bank's World Development Indicators (WDI). Since WDI starts in 1960 and does not contain information for some countries (e.g., Taiwan or Russia before 1989), we complement WDI with estimates provided by Angus Maddison.[10] The data on Free Trade agreements (FTA) are mainly constructed from three main sources: (1) Table 3 in Baier and Bergstrand (2007); (2) the WTO web site[11] and (3) qualitative information contained in Frankel (1997). The data on currency unions (CU) are an updated and extended version of the list provided by Glick and Rose (2002).[12] Bilateral real exchange rate is computed based on Penn World Table 7.0 (Heston *et al.*, 2011). Bilateral distance is calculated as the population-weighted great circle (geodesic) distance between the largest cities of the two countries and come from the CEPII distance database, as well as common (official) language, contiguity, common colonizer and colonial relationships.[13].

We use the data of Feyrer (2011) on time-to-ship to get a measure of the time it takes to trade between countries. The time required to travel from any oceanic point to each

[10] `http://www.ggdc.net/maddison`

[11] `http://www.wto.org/english/tratop_e/region_e/region_e.htm`

[12] Programs for constructing data on FTA and CU are available at `http://jdesousa.univ.free.fr/data.htm`.

[13] `http://www.cepii.fr/anglaisgraph/bdd/distances.htm`

of its trading partners is calculated by Feyrer (2011) using very detailed geographic data to reconstruct shortest shipping routes, and assuming a speed of 20 knots. Feyrer's data set covers 130 out of our 185 exporting countries and 59 out of our 69 importing countries. Thus, to avoid losing information on financial crises, we expand and amend his data set. Not surprisingly, the correlation between Feyrer's time-to-ship estimate and geodesic bilateral distance is high (.88). Not surprisingly either, the largest deviations are for contiguous countries. For those pairs of countries, we replace the time to ship value by the "time-to-road" based on the geodesic distance and assumed a speed of 60 knots.[14] Feyrer's sample also excludes landlocked countries and other countries such as Belgium. To recover bilateral information for those countries, we identified their closest primary port.[15] Then, for each landlocked country, we computed a time-to-road to that port and added the time-to-ship for each given destination. In robustness checks, we also run regressions using the simple geodesic distance as a proxy for the time it takes to trade between two countries, as well as the original Feyrer's time-to-ship.

Finally, we will also check the robustness of our results to the inclusion of financial development, proxied by the ratio of private credit over GDP from the WDI between 1960 and 2009.

3.3 Results

Baseline results. We want to study whether the fall in trade caused by a financial crisis in the destination country is magnified by time-to-ship between the origin and the destination country. Table 1 presents our baseline results, based on the estimation of different specifications of equation (10). In columns (1) and (2), we replace the country-pair fixed effects (μ_{ij}) with directional exporter and importer fixed effects. In columns (3) to (9), we include bilateral fixed effects (μ_{ij}). Additionally, in column (6), we control for importer $\times$ year, and in column (7) for both importer $\times$ year and exporter $\times$ year fixed effects.[16]

[14] This speed represents a reasonable average between a slower truck speed and a faster train speed.

[15] The data comes from http://www.e-ships.net/ports.php.

[16] For regressions (6) and (7), we make use of Guimaraes and Portugal (2010)'s algorithm to estimate models with high-dimensional fixed effects.

Table 1: Crises, time-to-ship and imports: Baseline results

Dependent Variable	ln Bilateral exports								
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ln GDP origin$_{it}$	0.91^a	0.91^a	0.89^a	0.89^a	0.89^a	1.00^a		0.88^a	0.88^a
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
ln GDP destination$_{jt}$	0.82^a	0.83^a	0.80^a	0.80^a	0.80^a			0.80^a	0.80^a
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)			(0.02)	(0.02)
FTA$_{ij}$	0.52^a	0.52^a	0.44^a	0.44^a	0.46^a	0.57^a	0.55^a	0.45^a	0.44^a
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Common currency$_{ijt}$	0.13^a	0.13^a	0.29^a	0.28^a	0.31^a	0.43^a	0.20^a	0.31^a	0.30^a
	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ln Real exchange rate$_{ijt}$	0.003	0.003	0.02^a	0.02^a	0.02^a	0.35^a	0.08^a	0.02^a	0.02^a
	(0.002)	(0.002)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)
ln time-to-ship$_{ij}$	-0.93^a	-0.92^a							
	(0.01)	(0.01)							
Banking crisis in destination$_{jt}$	-0.03^c	-0.06^a	-0.06^a	-0.07^a	-0.08^a				
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)				
Banking crisis$_{jt}$ × ln time-to-ship$_{ij}$		-0.11^a		-0.07^a	-0.08^a	-0.07^a	-0.08^a		
		(0.02)		(0.01)	(0.01)	(0.01)	(0.01)		
Banking crisis$_{jt}$ × FTA$_{ijt}$					-0.14^a				
					(0.03)				
Banking crisis$_{jt}$ × common legal$_{ij}$					0.02				
					(0.02)				
Banking crisis$_{jt}$ × common currency$_{ijt}$					-0.19^a				
					(0.05)				
Banking crisis$_{jt}$ × language$_{ij}$					0.01				
					(0.04)				
Banking crisis$_{jt}$ × contiguity$_{ij}$					0.04				
					(0.05)				
Post-2007 Banking crisis$_{jt}$								-0.36^a	-0.38^a
								(0.07)	(0.08)
Pre-2007 Banking crisis$_{jt}$								-0.02	-0.04^c
								(0.02)	(0.02)
Post-2007 Banking crisis$_{jt}$ × ln time-to-ship$_{ij}$									-0.06^b
									(0.03)
Pre-2007 Banking crisis$_{jt}$ × ln time-to-ship$_{ij}$									-0.08^a
									(0.01)
Observations	307462	307462	307462	307462	307462	307462	307462	307462	307462
R^2	0.734	0.734	0.856	0.856	0.856	0.868	0.563	0.856	0.856
Observations	307462	307462	307462	307462	307462	307462	307462	307462	307462
Country-pair fixed effects	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter and importer fixed effects	Yes	Yes	No	No	No	No	No	No	No
Importer × year fixed effects	No	No	No	No	No	Yes	Yes	No	No
Exporter × year fixed effects	No	No	No	No	No	No	Yes	No	No

Notes: Robust standard errors in parentheses, clustered by destination-year, with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Year dummies are included in all estimations. Time-to-ship is demeaned. In columns (1) and (2), estimates of time-invariant bilateral variables (contiguity, common language, common colonizer, colony, common legal origin) are not reported but available upon request.

The coefficients on the standard gravity determinants are significant and of the expected signs. When including country-pair fixed effect, a banking crisis in the destination country is found to decrease significantly bilateral exports, although the size of the effect is moderate: between -5.8% ($\exp(-0.06) - 1$) and -7.7% ($\exp(-0.08) - 1$) in columns (3) to (5). Time-to-ship however magnifies the response of trade to banking crises: the interaction term between the banking crisis dummy and bilateral time-to-ship is negative and significant at the 1% level (in columns 2 and 4 to 7). To give an order of magnitude, a one standard deviation increase of time-to-ship from the mean magnifies the effect of a banking crisis on imports from -7 to -10% in column (4).

To ensure that our results are not due to the correlation of time-to-ship with other bilateral characteristics that affect the response of trade to crises, we include in column (5) a number of additional interaction terms between bilateral variables (FTA, common currency, common language, common legal origin, and contiguity) and distance. Some of these interactions are indeed significant: for instance, a crisis in a destination country has a larger negative impact on bilateral trade if the two countries belong to the same trade agreement or currency union. These two effects are interesting and somewhat surprising. They suggest that our results on time-to-ship do not reflect the impact of financial crises on more fragile trade relations between countries that are both distant and without monetary or trade agreements. The interaction term on time-to-ship is unaffected by these controls.

The amplification effect of time-to-ship is remarkably stable when we include importer $\times$ year (column 6) or both importer $\times$ year and exporter $\times$ year dummies (column 7). In columns (8) and (9) of Table 1, we check whether the recent financial crisis has a different effect on trade compared with past crisis episodes. We thus split the banking crisis dummy into two variables: a dummy for the recent crisis, after 2007, and a dummy for previous crises. The recent crisis is found to have reduced trade more strongly (for a given fall in GDP and other controls): -30% ($\exp(-0.36) - 1$) for the recent crisis versus -2% (and statistically insignificant) for past crisis (column 8). The magnification effect of time-to-ship is however similar for crises before and after 2007 (column 9).

Robustness. In Table 2 we replicate the main estimations of Table 1 including dummies for banking crises in the exporter countries as well as an interaction term between these dummies and time-to-ship. Again we include either exporter and importer dummies (columns 1 and 2), country-pair fixed-effects (columns 3 and 4), country-pair and importer×year (column 5) or country-pair, importer×year and exporter×year fixed effects (column 6).

Table 2: Crises, time-to-ship and exports

Dependent Variable	ln Bilateral exports					
Model	(1)	(2)	(3)	(4)	(5)	(6)
ln GDP origin$_{it}$	0.95^a	0.95^a	0.87^a	0.88^a	1.09^a	
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
ln GDP destination$_{jt}$	0.87^a	0.87^a	0.83^a	0.84^a		
	(0.02)	(0.02)	(0.02)	(0.02)		
FTA$_{ijt}$	0.40^a	0.39^a	0.36^a	0.35^a	0.51^a	0.54^a
	(0.02)	(0.02)	(0.01)	(0.01)	(0.02)	(0.02)
Common currency$_{ijt}$	0.10^b	0.09^b	0.14^a	0.13^a	0.37^a	0.26^a
	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
ln Real exchange rate$_{ijt}$	0.003	0.003	0.01^a	0.01^a	0.52^a	0.14^a
	(0.002)	(0.002)	(0.00)	(0.00)	(0.01)	(0.01)
ln time-to-ship$_{ij}$	-0.88^a	-0.85^a				
	(0.01)	(0.01)				
Banking crisis in destination$_{jt}$	-0.03^c	-0.06^a	-0.05^a	-0.07^a		
	(0.02)	(0.02)	(0.02)	(0.02)		
Banking crisis in origin$_{it}$	0.03^b	0.01	0.01	0.003	0.005	
	(0.01)	(0.01)	(0.01)	(0.010)	(0.010)	
Banking crisis$_{jt}$ × ln time-to-ship$_{ij}$		-0.11^a		-0.06^a	-0.06^a	-0.06^a
		(0.02)		(0.01)	(0.01)	(0.01)
Banking crisis$_{it}$× ln time-to-ship$_{ij}$		-0.08^a		-0.02^b	-0.03^a	-0.12^a
		(0.01)		(0.01)	(0.01)	(0.01)
Observations	185948	185948	185948	185948	185948	185948
Country-pair fixed effects	No	No	Yes	Yes	Yes	Yes
Exporter and importer fixed effects	Yes	Yes	No	No	No	No
Importer × year fixed effects	No	No	No	No	Yes	Yes
Exporter × year fixed effects	No	No	No	No	No	Yes

Notes: Robust standard errors in parentheses, clustered by destination-year, with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Year dummies are included in all estimations. Time-to-ship is demeaned. In columns (1) and (2), estimates of time-invariant bilateral variables (contiguity, common language, common colonizer, colony, common legal origin) are not reported.

Our baseline results are again unaffected: the interaction term between banking crisis in the importer country and time-to-ship is still negative and significant. A banking crisis in the exporter country has a slightly positive or insignificant impact on exports depending on the specification, a result consistent with Abiad *et al.* (2011). However, the interaction term between banking crisis in the exporter country and the time-to-ship is negative (columns 2, and 4 to 6). This may be interpreted in light of our model if a banking crisis in the exporter country is an indication of funding stress for exporters. In equation (7), note that an increase in the interest rate at which exporters borrow has the same qualitative effect as an increase in the probability of default in the importer country. Both effects on trade are amplified by time-to-ship. A banking crisis is a rough indicator of the difficulty and cost of borrowing for exporters but the result is suggestive of the same type of mechanism as the probability of default of importers on which we focus.

In Table 3, we conduct several robustness tests starting from regression (3) in Table 1. So all regressions include country-pair fixed effects and year dummies. One might argue that our results are driven by an increase in the elasticity of trade to time-to-ship over time.[17] As the number of banking crises increases over time (see Figure 1 in Appendix A.1), this could bias our results. Our amplification effect of time-to-ship might also capture the fact that crises have become both more frequent and distant over time. In regression (1) in Table 3, we include a full set set of interactions between year dummies and our crisis variable (to control for their increased frequency) and between year dummies and time-to-ship (to control for its potential increased impact over time). As shown in column (1), the interaction between crises and time-to-ship remains significant at the 1% level.

In regression (2), we replace the measure of time-to-ship that we expanded from Feyrer (2011) by his original measure, which implies the loss of many observations. In regression (3), we use simple distance as an alternative measure for time-to-ship. The effect is similar in both cases. Distance and our measure of time-to-ship are very correlated but as explained before differ for certain pairs of countries, in particular contiguous ones. Remember that our theoretical framework generates a radically different role for trade costs, such as distance, and for time-to-ship. Both distance and time-to-ship, because they increase trade costs, reduce trade flows but only time-to-ship raises the elasticity of trade to financial risk. In order to check whether distance per se or time-to-ship is at the source of our main results, we include both interaction terms in regression (4). As predicted by theory, the distance interaction looses its significance but the time-to-ship interaction remains similar in size and

[17]Time-to-ship is highly correlated with distance, and the impact of distance on trade has been shown to increase over time (Disdier and Head, 2008).

Table 3: Crises, time-to-ship and imports: robustness

Dependent Variable	ln Bilateral exports							
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln GDP origin_{it}	0.89^a	0.87^a	0.88^a	0.89^a	0.89^a	0.89^a	0.89^a	0.95^a
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ln GDP destination_{jt}	0.80^a	0.80^a	0.81^a	0.80^a	0.90^a	0.80^a	0.80^a	0.84^a
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)
FTA_{ijt}	0.37^a	0.37^a	0.45^a	0.44^a	0.37^a	0.44^a	0.44^a	0.36^a
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Common currency_{ijt}	0.29^a	0.22^a	0.30^a	0.28^a	0.25^a	0.28^a	0.28^a	0.15^a
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ln Real exchange rate_{ijt}	0.02^a	0.02^a	0.02^a	0.02^a	0.02^a	0.02^a	0.02^a	0.03^a
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Banking crisis_{jt} × ln time-to-ship_{ij}	-0.06^a			-0.07^a	-0.05^a		-0.06^a	-0.04^a
	(0.01)			(0.02)	(0.01)		(0.01)	(0.01)
Banking crisis in destination_{jt}		-0.06^a	-0.08^a	-0.07^a	-0.07^a		-0.07^a	-0.06^a
		(0.02)	(0.02)	(0.02)	(0.02)		(0.02)	(0.02)
Banking crisis_{jt} × ln time-to-ship_{ij} (Feyrer)		-0.08^a						
		(0.01)						
Banking crisis_{jt} × ln distance_{ij}			-0.07^a	-0.0001				
			(0.01)	(0.0199)				
ln time-to-ship_{ij} × ln GDP destination_{jt}					-0.03^a			
					(0.00)			
Currency crisis in destination_{jt}						-0.04^b	-0.03^c	
						(0.02)	(0.02)	
Currency crisis_{jt} × ln time-to-ship_{ij}						-0.04^a	-0.04^a	
						(0.01)	(0.01)	
Banking crisis_{jt} × financial dev. distance_{ijt}								-0.002^a
								(0.0001)
Observations	307462	222873	317456	307462	307462	307241	307241	254921
R^2	0.857	0.855	0.856	0.856	0.856	0.856	0.856	0.875

Notes: Robust standard errors in parentheses, clustered by destination-year, with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Bilateral fixed effects and year dummies are included in all estimations. Time-to-ship and distance are demeaned. Column (1) includes a full set of unreported interactions between year dummies and banking crises, and between year dummies and time-to-ship. Column (2) uses the original Feyrer's time-to-ship but reduces the sample coverage. In column (8), "Financial dev." means financial development and the time coverage is 1960-2009.

very significant. This suggests that time-to-ship and not distance is at the source of our amplification result. In regression (5), we include an interaction term between time-to-ship and the GDP of the destination country. The objective is to check whether the time-to-ship amplification effect comes from a demand effect of the financial crisis that lowers income. We see first that in periods with low GDP importer countries import relatively more from countries with higher time-to-ship. More importantly, the interaction term between time-to-ship and the banking crisis is not much affected. In regression (6), we use an alternative measure of financial risk in the destination country and replace the banking crisis dummy by a currency crisis dummy (also coming from Reinhart and Rogoff, 2011). We see that the interaction term with time-to-ship exhibits a similar effect. In regression (7), we interact both the banking crisis dummy and the currency crisis with time-to-ship. Estimates are both significant and quantitatively similar. This suggests that other financial risks, such as currency crises which may also put into danger international payments, have similar effects to banking crisis. Finally, in the last regression, we check whether our time-to-ship measure does not capture the effect of a distance between the financial development of the trade partners that could amplify the impact of the financial crisis on their trade. The time-to-ship interaction term remains very significant in this case.

Table 10 in Appendix A.2 reports further robustness checks. Time-to-ship may be correlated with importer or exporter characteristics that affect their responses to financial crises. We therefore interact the banking crisis dummy with the economic size (GDP) or the financial development level of the importer or the exporter. We find that a crisis in the importing country has a larger negative effect when the exporter is economically smaller (column 1), or when the importer is economically larger (column 2) and more financially developed (column 4). Moreover, when the exporter is a developing country, a crisis in the importing country has a more negative effect on trade (column 5). This is consistent with Berman and Martin (2012) who find that exports of Sub-Saharan African countries are hit harder than the average when a crisis occurs in their partner countries. In regression (6), we add interaction terms between regions for the origin country and the banking crisis dummy in destination to check whether our results are due to a specific region in the world. We see this is not the case. In that table, it is worth noting that, across specifications, the estimate of the interaction between crisis and time-to-ship remains highly significant and remarkably stable.

In Figure 2 in appendix, we test whether the effect of banking crises on imports and the magnification effect of time-to-ship builds up through time, i.e. if these effects are amplified as the crisis lasts. We start from our baseline specification (Table 1, column (4)) but replace the crisis variable by a set of dummies representing the number of years since the crisis started. More precisely, we split our crisis variable into four dummies which equal 1 respectively if the importer country is (i) in the first year of the crisis; (ii) in the second to fourth year; (iii) in the fifth to the ninth year; (iv) if the crisis started more 10 years before or more. We further interact these bins with the (demeaned) time-to-ship variable. Figure 2.a plots the deviation of bilateral imports during a crisis depending on its duration. The x-axis represents the "natural" trade level as given by the gravity equation, and the figure can therefore be interpreted as the deviation from this level. The 90% confidence intervals are depicted by dotted lines around the estimated effect. Figure 2.b represents the magnification effect of time-to-ship. Both the average effect of the crisis and the effect of time-to-ship are found to increase (in absolute value) as the crisis lasts. This can be understood as follows: a crisis destroys imports, which deviate from their natural level; as long as the crisis continues, more trade is destroyed and trade moves further away from its natural level.

Finally, in Appendix A.3, we present further evidence of the amplification effect of time-to-ship on sectoral trade. The negative effect of time-to-ship is observed in various sectors, suggesting that our results are not due to composition effects.

4 Firm-level evidence

Data. We use the firm-destination specific export data from the French customs over the period 1995-2005. This database reports the volume (in tons) and value (in euros) of exports for each product (combined nomenclature) and destination, for each firm located on the French metropolitan territory. Unit values are computed as the ratio of export value divided by export volume. These are therefore imperfect measures of export prices. Some shipments are excluded from this data collection. Inside the European Union (EU), firms are required to report their shipments by product and destination country only if their annual trade value exceeds the threshold of 150,000 euros. For exports outside the EU all flows are recorded, unless their value is smaller than 1000 euros or one ton. Those thresholds only eliminate a very small proportion of total exports. As unit values and export volumes can be noisy we clean the data by dropping the observations for which the yearly growth rate of one of these variables was in the top or bottom 1% of the distribution, computed by year.

We match this data set with Reinhart and Rogoff (2011)'s banking crises data in destination countries between 1995 and 2005. Moreover, as we want to estimate variants of the specification (10) for French firms exports, we add destination specific variables, such as GDP, real exchange rate, FTA and common currency (euro) (see section 3.2 for details on the construction of these variables). For time-to-ship, we use the same methodology and source as in the previous section. In this section, we only use time-to-ship between France and the countries it exports to. In a previous version of the paper we also had computed a time-to-ship measure from a different source: we computed the amount of time (in days) required to ship from France's main sea port (Le Havre) to each to the destination countries' main sea ports. The data come from Sea Rates, a sea-freight broker based in Miami, Florida (`http://www.searates.com`). Sea Rates provides the estimated shipping time which depends on the actual itinerary of the ship which takes into account the crossing of international canals such as Panama, Suez, but also the Saint Lawrence seaway or the Kiel canal linking the North sea to the Baltic sea. Our results are very similar to those obtained with Feyrer data so we do not report them here. They are available upon request.

Results. We assess the impact of financial crises in the destination countries on the intensive and extensive margins on trade at the firm-level. We also estimate whether this impact is magnified by shipping time. Table 4 depicts the results on the intensive margin. Columns (1) to (3) report the estimations on unit values, columns (4) to (6) on export volumes, and columns (7) to (9) on export values. Note that similar results are obtained when the log of destination GDP is included in the unit value regressions (columns 1 to 3), which is not required theoretically. All columns show within estimations since they include fixed effects at the firm-destination level. Year dummies are also added.

Consistent with our theory, French firms are found to react to a financial crisis in the destination country by increasing their prices (column 1), and decreasing their export volumes and values (columns 4 and 6). This suggests therefore that there is pricing-to-market which responds to the financial condition of the destination country, in this specific case, the increased risk that comes with a financial crisis. All these effects are significant at the 1% level. Unit values increase by around 3% on average (column 1), and export volumes decrease by 12% (column 4). This leads to a 9% decrease in export values (column 7). Time-to-ship affects the way in which quantities and values react to crises, in a way consistent with the

Table 4: Crises, time-to-ship and exports: firm-level results (prices, volumes and values)

Dependent variable	ln Unit Value$_{ijt}$			ln Trade Volume$_{ijt}$			ln Trade Value$_{ijt}$		
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Banking crisis$_{jt}$	0.03^a	0.04^a	0.04^a	-0.12^a	-0.00	-0.00	-0.09^a	0.01	0.01
	(0.01)	(0.01)	(0.01)	(0.02)	(0.04)	(0.04)	(0.02)	(0.04)	(0.04)
ln Real Exchange Rate$_{jt}$	0.11^a	0.11^a	0.11^a	0.49^a	0.50^a	0.50^a	0.58^a	0.58^a	0.59^a
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Common currency$_{jt}$	-0.00	-0.00	-0.00	0.07^b	0.07^b	0.07^b	0.05^c	0.05^c	0.05^c
	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
FTA$_{jt}$	-0.02	-0.01	-0.02^c	0.00	0.00	0.00	0.00	0.00	0.00
	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.02)
Banking crisis$_{jt}$ × Shipping time$_j$		-0.01	0.02		-0.10^b	-0.14^b		-0.08^b	-0.12^c
		(0.01)	(0.02)		(0.04)	(0.07)		(0.04)	(0.06)
Banking crisis$_{jt}$ × ln distance$_j$			-0.03^c			0.06			0.04
			(0.02)			(0.06)			(0.05)
ln GDP$_{jt}$				0.94^a	0.96^a	0.96^a	0.83^a	0.84^a	0.84^a
				(0.10)	(0.10)	(0.10)	(0.09)	(0.10)	(0.10)
Observations	2721451	2721451	2721451	2721451	2721451	2721451	2721451	2721451	2721451

Notes: Robust standard errors in parentheses, clustered by destination-year, with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Year and firm-destination dummies are included in all estimations.

model and our aggregate results: the drop of exports is larger for destinations with higher time-to-ship (columns 5 and 8). On unit values, however, the coefficient on the interaction term between crises and time-to-ship is not statistically significant (columns 2 and 3).

Interestingly, when we include both distance and time-to-ship in our estimations (except in column 3), only the interaction with time-to-ship remains significant (despite the very high correlation between the two variables) - at the 5% level in column (6) and at the 10% level in column (9).

The impact of longer time-to-ship on the effect of financial crises is also significant quantitatively. To give an idea of the magnitude of the effect, in column (5) an increase in time-to-ship from 10 to 20 days magnifies the drop of export volumes during a financial crisis from -1% to -8% (-12% for 30 days of time-to-ship). For export values, the effect is insignificant for 10 days but drops to -6% for 20 days, and up to -10% after 30 days (col. 8).

Table 5 contains the results on the extensive margin. We estimate the probability that a given firm exits from a given destination, and how it depends on the occurrence of banking crises and other destination-specific variables. We either use fixed effect logit estimations (columns 1 to 3) or linear estimations with firm-destination fixed effects (columns 4 to 6). Note that as these are within estimations, any firm-destination that contains only zeros or ones is not considered. Again, in all estimations year dummies are included. The dependent variable is the probability that a firm i *does not* export to a destination j during year t, conditional on exporting in $t-1$.

Table 5: Crises and exports: firm-level results, extensive margin

Dependent variable	$\Pr(\text{Exit}_{ijt} > 0)$					
Model	(1)	(2)	(3)	(4)	(5)	(6)
Estimator		FE Logit			LPM	
Banking crisis$_{jt}$	0.219^a	0.026	0.027	0.038^a	-0.003	-0.002
	(0.012)	(0.025)	(0.025)	(0.003)	(0.006)	(0.006)
ln GDP$_{jt}$	-1.841^a	-1.859^a	-1.866^a	-0.293^a	-0.298^a	-0.299^a
	(0.042)	(0.042)	(0.042)	(0.010)	(0.010)	(0.010)
ln Real Exchange Rate$_{jt}$	-0.769^a	-0.773^a	-0.778^a	-0.172^a	-0.173^a	-0.173^a
	(0.024)	(0.024)	(0.024)	(0.005)	(0.005)	(0.005)
Banking crisis$_{jt}$ × Shipping time$_j$		0.191^a	0.273^a		0.040^a	0.042^a
		(0.021)	(0.037)		(0.005)	(0.009)
Banking crisis$_{jt}$ × ln distance$_j$			-0.098^a			-0.003
			(0.036)			(0.008)
Observations	1717848	1717848	1717848	1717848	1717848	1717848

Notes: Standard errors (robust for LPM estimations) in parentheses with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. $\Pr(\text{Exit}_{ijt} > 0)$ is the probability that a firm i does not export to market j during year t, conditional on positive exports in year $t-1$. Year dummies and firm-destination fixed effects are included in all estimations.

Unsurprisingly, a crisis increases the probability to exit a given destination in the year of the financial crisis. The average effect is however quantitatively low: in column (4), the exit probability increases by less than 4 percentage points during crises episodes. This is consistent with Bricongne *et al.* (2012) who find that during the 2008-2009 financial crisis, most of the fall in exports by French firms was due to the intensive margin. Note however that this effect comes on top of the income drop that itself increases the exit probability. As predicted by theory, the effect of the financial crisis on the exit probability is amplified by higher time-to-ship (columns 2, 3 and 5 and 6).

5 Conclusion

This paper has documented a robust stylized fact, and discussed a possible mechanism underlying it. When a country is hit by a financial crisis, its imports decrease more when the time-to-ship to the partner country is higher. It was the case during the recent trade collapse, but also in past crises. At the aggregate level, this result is robust to the inclusion of various controls or to the use of alternative estimators. It is also observed at the sectoral level and at the firm-level on a large panel of French firms over the period 1995-2005. The effect of crises in destination countries is magnified at both the intensive (export volumes and values) and the extensive margin (exit probability) levels.

What is the reason behind this magnification effect of time-to-ship? We argue that the time-to-ship amplification may be considered as a footprint left by a financial friction specific to international trade. The risk associated with longer shipping time is heightened during financial crisis, as the probability that an importer defaults on his payment obligation increases as time passes. Our model has implications at the firm level on exporter prices, quantities and entry-exit adjustment during financial crises which are broadly consistent with the data. Importantly, time-to-ship in our framework is not only a trade cost, it increases the elasticity of trade to financial risk.

The mechanism that we analyze may have larger implications for how financial frictions and risk both at the aggregate and at the individual level affect trade patterns in particular at the business cycle frequency.[18] In particular, interest rate changes, exchange rate volatility may affect international trade through this mechanism and be amplified by time-to-ship. We leave these theoretical and empirical questions for future research.

[18] As shown theoretically by Martin and Rey (2006), an increase in trade frictions during financial crises may increase the likelihood of a financial crisis. This points to a mechanism where financial crises and trade frictions are jointly and endogenously determined

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A Appendix

A.1 Descriptive statistics

Figure 1: Share of observations with banking crises, by year

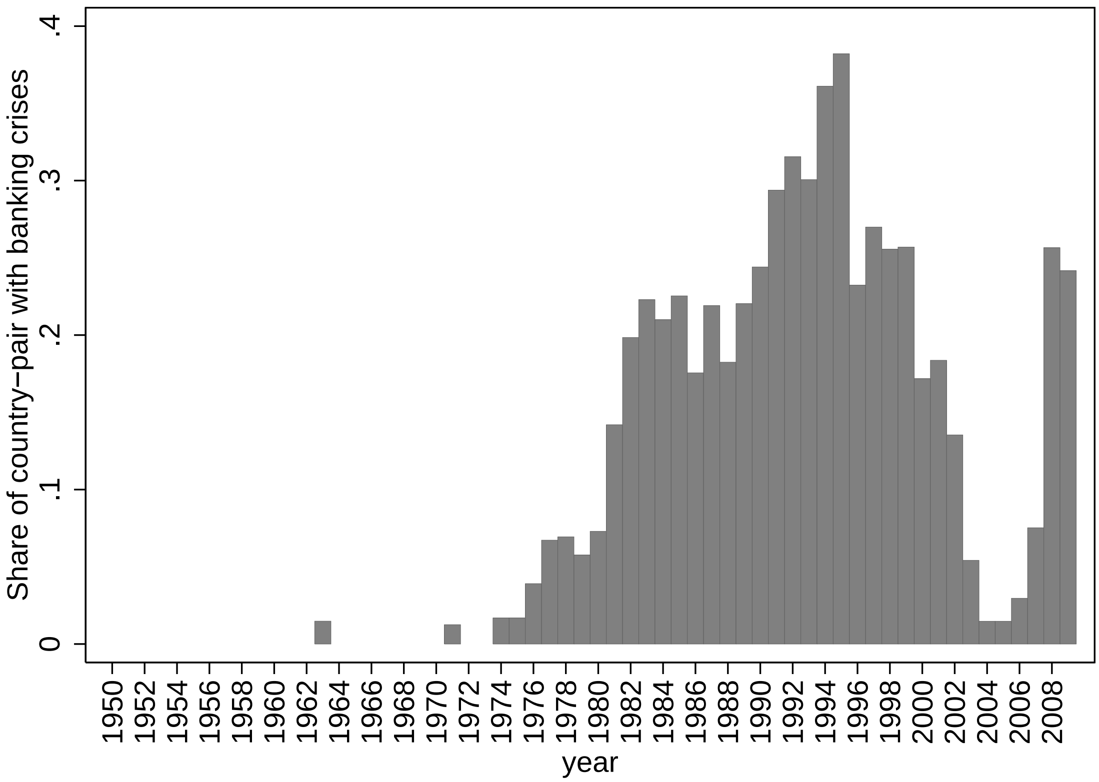


Table 6: List of countries

Afghanistan	Gabon	Oman
Albania	Gambia	Pakistan
Algeria†	Georgia	Palau
Angola†	Germany†	Panama†
Antigua and Barbuda	Ghana†	Papua New Guinea
Argentina†	Greece†	Paraguay†
Armenia	Grenada	Peru†
Australia†	Guatemala†	Philippines†
Austria†	Guinea	Poland†
Azerbaijan	Guinea-Bissau	Portugal†
Bahamas	Guyana	Qatar
Bahrain	Haiti	Romania†
Bangladesh	Honduras†	Russian Federation†
Barbados	Hong Kong	Rwanda
Belarus	Hungary†	Saint Kitts and Nevis
Belgium†	Iceland†	Saint Lucia
Belize	India†	Saint Vincent and the Grenadines
Benin	Indonesia†	Samoa
Bermuda	Iran	Sao Tome and Principe
Bhutan	Iraq	Saudi Arabia
Bolivia†	Ireland†	Senegal
Bosnia and Herzegovina	Israel	Seychelles
Botswana	Italy†	Sierra Leone
Brazil†	Jamaica	Singapore†
Brunei Darussalam	Japan†	Slovak Republic
Bulgaria	Jordan	Slovenia
Burkina Faso	Kazakhstan	Solomon Islands
Burundi	Kenya†	Somalia
Cambodia	Kiribati	South Africa†
Cameroon	Korea (Republic of)†	Spain†
Canada†	Kuwait	Sri Lanka†
Cape Verde	Kyrgyzstan	Sudan
Central African Republic†	Laos	Suriname
Chad	Latvia	Swaziland
Chile†	Lebanon	Sweden†
China†	Lesotho	Switzerland†
Colombia†	Liberia	Syria
Comoros	Libya	Taiwan†
Congo	Lithuania	Tajikistan
Costa Rica†	Macau	Tanzania
Cote D'Ivoire†	Macedonia	Thailand†
Croatia	Madagascar	Togo
Cuba	Malawi	Tonga
Cyprus	Malaysia†	Trinidad and Tobago
Czech Republic	Maldives	Tunisia†
Czechoslovakia	Mali	Turkey†
Dem. Rep. of the Congo	Malta	Turkmenistan
Denmark†	Mauritania	Uganda
Djibouti	Mauritius†	Ukraine
Dominica	Mexico†	United Arab Emirates
Dominican Republic†	Moldova	United Kingdom†
Ecuador†	Mongolia	United States†
Egypt†	Morocco†	Uruguay†
El Salvador†	Mozambique	Uzbekistan
Equatorial Guinea	Namibia	Vanuatu
Eritrea	Nepal	Venezuela†
Estonia	Netherlands†	Viet Nam
Ethiopia	New Zealand†	Yemen
Fiji	Nicaragua†	Yugoslavia
Finland†	Niger	Zambia†
Former Soviet Union	Nigeria†	Zimbabwe†
France†	Norway†	

Note: † indicates countries covered in the Reinhart and Rogoff (2011)'s historical data set on financial crises.

Table 7: Banking crises, starting dates

Country	**Crises (start)**	**Country**	**Crises (start)**
Algeria	1990	Korea (Republic of)	1983,1986,1997
Angola	1992	Malaysia	1985,1997
Argentina	1980,1989,1995,2001	Mauritius†	-
Australia	1989	Mexico	1981,1994
Austria	2008	Morocco	1983
Belgium	2008	Netherlands	2008
Bolivia	1987,1994	New Zealand	1987
Brazil	1963,1985,1990,1994	Nicaragua	1987,2000
Canada	1983	Nigeria	1992,1997
Central African Republic	1976,1988	Norway	1987,1991
Chile	1976,1980	Panama	1988
China	1997	Paraguay	1995,2002
Colombia	1982,1998	Peru	1983,1987,1999
Costa Rica	1987,1994	Philippines	1981,1997
Cote d'Ivoire	1988	Poland	1991
Denmark	1987,2008	Portugal	2008
Dominican Republic	1996,2003	Romania	1990
Ecuador	1981,1994,1996,1998	Russian Federation	1995,1998,2008
Egypt	1981,1990	Singapore	1982
El Salvador	1989,1998	South Africa	1977,1989
Finland	1991	Spain	1977,2008
Germany	1977,2008	Sri Lanka	1989
Ghana	1982,1997	Sweden	1991
Greece	1991,2008	Switzerland	2008
Guatemala	1991,2001,2006	Taiwan	1983,1995,1997
Honduras	1999,2001	Thailand	1979,1983,1996
Hungary	1991,2008	Tunisia	1991
Iceland	1985,1993,2007	Turkey	1982,1991,1994,2000
India	1993	United Kingdom	1974,1984,1991,1995
Indonesia	1992,1997	United States	1984,2007
Ireland	2007	Uruguay	1981,2002
Italy	1990	Venezuela	1978,1993
Japan	1992	Zambia	1995
Kenya	1985,1992	Zimbabwe	1995
France	1994,2008		

Source: Reinhart and Rogoff (2011). Note: † Mauritius faced various currency crisis with the following starting dates: 1979, 1981, 1983, 1997.

Table 8: Time-to-ship between France and the 68 destination countries

Country	Number of days	Country	Number of days
Algeria	7.2	Korea (Republic of)	45.1
Angola	20.3	Malaysia	33.8
Argentina	26.2	Mauritius	29.3
Australia	48.4	Mexico	21.0
Austria	12.1	Morocco	5.4
Belgium	0.2	Netherlands	1.0
Bolivia	31.1	New Zealand	47.0
Brazil	21.7	Nicaragua	22.7
Canada	13.6	Nigeria	17.2
Central African Republic	19.1	Norway	2.9
Chile	30.9	Panama	19.8
China	43.5	Paraguay	26.8
Colombia	18.4	Peru	25.5
Costa Rica	21.7	Philippines	39.8
Cote D'Ivoire	15.2	Poland	4.4
Denmark	3.2	Portugal	4.0
Dominican Republic	16.3	Romania	13.5
Ecuador	23.0	Russian Federation	6.3
Egypt	12.8	Singapore	34.5
El Salvador	23.3	South Africa	25.3
Finland	5.7	Spain	0.7
Germany	0.3	Sri Lanka	28.1
Ghana	16.2	Sweden	2.8
Greece	11.3	Switzerland	0.3
Guatemala	23.5	Taiwan	40.3
Honduras	23.0	Thailand	37.8
Hungary	12.2	Tunisia	8.6
Iceland	5.6	Turkey	12.1
India	26.3	United Kingdom	0.5
Indonesia	35.6	United States	13.6
Ireland	2.1	Uruguay	25.8
Italy	0.8	Venezuela	17.4
Japan	46.5	Zambia	31.1
Kenya	26.2	Zimbabwe	30.9
Average (number of days): 19.4			

Note: The primary source for time-to-ship data is Feyrer (2011). Details about our extension are given in the text.

Table 9: Mean by categories of the banking crises dummy

Banking Crisis$_{jt}$	ln Exports$_{ijt}$	ln Distance$_{ij}$	Contiguity	Com. Language	
0	15.75	8.63	0.03	0.16	
1	16.00	8.69	0.03	0.14	
Total	15.78	8.64	0.03	0.16	
Banking Crisis$_{jt}$	Com. Colonizer	Colony	Com. Legal Origin	FTA	Com. Currency
0	0.04	0.03	0.36	0.06	0.01
1	0.04	0.03	0.36	0.07	0.01
Total	0.04	0.03	0.36	0.06	0.01

Note: Com. means Common.

A.2 Aggregate robustness

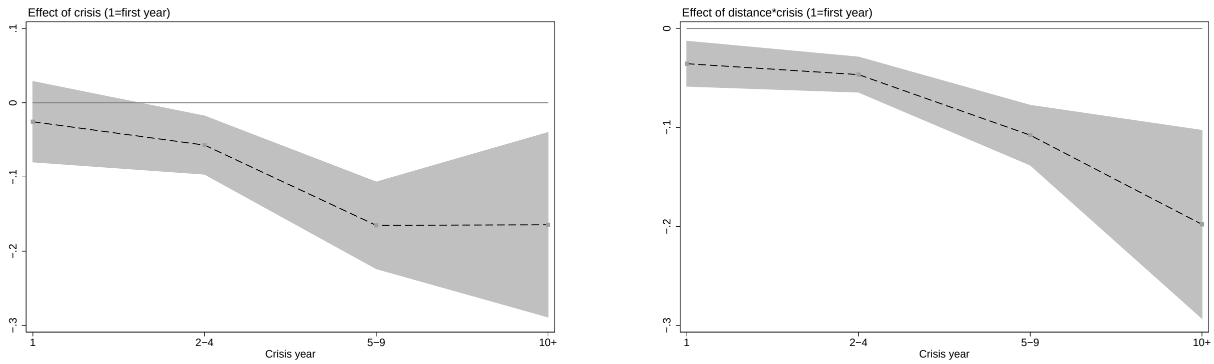
Table 10: Crises, time-to-ship and imports: Additional robustness

Dependent Variable	ln Bilateral exports					
Model	(1)	(2)	(3)	(4)	(5)	(6)
ln GDP origin$_{it}$	0.88^a	0.88^a	0.95^a	0.86^a	0.88^a	0.88^a
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
ln GDP destination$_{jt}$	0.80^a	0.81^a	0.81^a	0.87^a	0.80^a	0.80^a
	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
FTA$_{ijt}$	0.44^a	0.44^a	0.36^a	0.41^a	0.44^a	0.44^a
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Common currency$_{ijt}$	0.28^a	0.28^a	0.15^a	0.26^a	0.28^a	0.28^a
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
ln Real exchange rate$_{ijt}$	0.02^a	0.02^a	0.02^a	0.03^a	0.02^a	0.02^a
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Banking crisis in destination$_{jt}$	-0.33^a	0.22^b	-0.07^a	0.05^c	-0.005	
	(0.07)	(0.10)	(0.02)	(0.03)	(0.021)	
Banking crisis$_{jt}$ × ln time-to-ship$_{ij}$	-0.07^a	-0.06^a	-0.05^a	-0.05^a	-0.07^a	-0.08^a
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Banking crisis$_{jt}$ × ln GDP origin$_{it}$	0.02^a					
	(0.01)					
Banking crisis$_{jt}$ × ln GDP destination$_{jt}$		-0.03^a				
		(0.01)				
Financial development origin$_{it}$			0.10^a			
			(0.01)			
Banking crisis$_{jt}$ × Financial development origin$_{it}$			-0.01			
			(0.02)			
Financial development destination$_{jt}$				-0.11^a		
				(0.03)		
Banking crisis$_{jt}$ × Financial development destination$_{jt}$				-0.13^a		
				(0.03)		
Banking crisis$_{jt}$ × Developing country$_{it}$					-0.09^a	
					(0.02)	
Banking crisis$_{jt}$ × North America$_i$						0.05^b
						(0.03)
Banking crisis$_{jt}$ × South America$_i$						-0.09^a
						(0.03)
Banking crisis$_{jt}$ × Europe$_i$						-0.01
						(0.02)
Banking crisis$_{jt}$ × Central_East_Europe$_i$						-0.12^a
						(0.03)
Banking crisis$_{jt}$ × NAfrica MEast$_i$						-0.18^a
						(0.04)
Banking crisis$_{jt}$ × SSAfrica$_i$						-0.19^a
						(0.04)
Banking crisis$_{jt}$ × SE_Asia$_i$						-0.002
						(0.037)
Banking crisis$_{jt}$ × E_Asia$_i$						0.09^a
						(0.03)
Observations	307462	307462	264102	282053	307462	307462

Notes: Robust standard errors in parentheses, clustered by destination-year, with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Bilateral fixed effects and year dummies are included in all estimations. Time-to-ship is demeaned. Columns (3) and (4): due to data availability on financial development, the sample period is 1960-2009.

Figure 2: Time-to-ship and the duration of financial crises

(a) Effect of banking crises on imports (b) Effect of time-to-ship×banking crises on imports



A.3 Sectoral evidence

This appendix presents further evidence of the banking crises and the amplification effect of time-to-ship on sectoral trade. To run our analysis, we use a constructed data set of 26 International Standard Industrial Classification (Revision 2) 3-digit industries, 181 exporting countries and 69 importing countries. The list of sectors and ISIC codes are tabulated in Table 11. The country coverage is the same as in the aggregate-level analysis. Table 6 lists countries in our sample and indicates countries covered in the Reinhart and Rogoff (2011)'s data set. Again, the lower number of importing countries is due to the availability of the banking crises data. However, the time period coverage is shorter from 1980 to 2009 instead of 1950-2009.[19]

Table 11 presents the results of the estimates of the interaction term between the banking crisis dummy and time-to-ship, sector by sector, for the period 1980-2009. The specification is the same as the one used in column (2) of Table 1 with country and time fixed effects, as well as controls for the bilateral and unilateral factors affecting trade. Overall estimates are

[19] See de Sousa, Mayer and Zignago (2011) for more details on the construction of the sectoral data set from 1980 to 2006. We expanded this data set until 2009 to cover the most recent financial crisis.

available upon request.

The estimates of the interaction term between the banking crisis dummy and time-to-ship are sorted according to their magnitude. More than half of the estimates are significant and in line with the aggregate point estimates of Table 1. The largest amplification effects are found in the divisions 31 (manufacture of food, beverages and tobacco) and 38 (manufacture of fabricated metal products, machinery and equipment). In contrast, no amplification effect is found in the division 32 (textile, wearing apparel and leather industries).

Table 11: Crises, time-to-ship and exports: sectoral evidence

Industry	ISIC code	Estimate of Banking $\text{crisis}_{jt} \times \ln \text{time-to-ship}_{ij}$	Clustered standard errors	Observations
Beverages	313	-0.093^{a}	0.025	88838
Mach elec	383	-0.091^{a}	0.026	143642
Prof/Sci	385	-0.087^{a}	0.023	121974
Machines	382	-0.087^{a}	0.024	151935
Food	311	-0.085^{a}	0.020	143115
Oth Chem.	352	-0.084^{a}	0.025	125391
Tobacco	314	-0.083^{a}	0.028	41561
Transport	384	-0.074^{a}	0.022	126479
Ind. Chem.	351	-0.072^{a}	0.021	130492
Printing	342	-0.062^{a}	0.022	111875
Glass	362	-0.057^{a}	0.021	92892
Rubber	355	-0.055^{b}	0.023	100947
Nf metals	372	-0.052^{b}	0.021	100550
Non-metal	369	-0.042^{c}	0.022	91468
Paper	341	-0.040^{c}	0.024	100526
Metal prod	381	-0.036^{c}	0.022	134867
Plastic	356	-0.033	0.026	109972
Wood	331	-0.027	0.018	104221
Textiles	321	-0.017	0.023	142457
Pottery	361	-0.012	0.021	82052
Iron/steel	371	-0.011	0.023	99436
Petroleum	353	0.006	0.024	72338
Apparel	322	0.019	0.024	125436
Footwear	324	0.021	0.025	79901
Leather	323	0.025	0.022	100221
Furniture	332	0.026	0.023	92536

Notes: Robust standard errors in parentheses, clustered by destination-year, with ^{a}, ^{b}, and ^{c} respectively denoting significance at the 1%, 5% and 10% levels. Each row reports the sectoral estimate of the interaction Banking $\text{crisis}_{jt} \times \ln \text{time-to-ship}_{ij}$. The specification is the same as the one used in column (2) of Table 1, including ln GDP_{it}, ln GDP_{jt}, FTA_{ijt}, Common currency_{ijt}, ln Real Exchange Rate_{ijt}, ln Time-to-ship_{ij}, Banking crisis in destination_{jt}, Contiguity_{ij}, Common language_{ij}, Common colonizer_{ij}, Colony_{ij}, Common legal origin_{ij}, as well as importer, exporter and year dummies. Time-to-ship is demeaned. The sample period is 1980-2009. See `http://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=8&Lg=1` for a description of the ISIC Revision 2 industries.