Trade Finance, Differentiated Goods, and Financial Crises

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Abstract

Building on the theoretical model by Melitz (2003) and the extension of financial constraints by Manova (2013), this paper finds that the cost of trade finance has a larger effect on the exports of differentiated goods than on the exports of homogenous goods: a one percentage point increase in the one-month interbank rate decreases total exports by 0.4–1% and differentiated goods exports by 0.6%. On the other hand, homogenous goods exports are not significantly affected. Furthermore, the elasticity of exports w.r.t. gross domestic product (GDP) is larger for differentiated goods than homogenous goods, also explaining why differentiated goods exports declined more during the crisis. Finally, a banking crisis in the importing country decreases bilateral exports of differentiated goods by 5.5%, while homogenous goods are again unaffected. However, a domestic crisis does not have any significant effect on exports, as its effect is already largely accounted for by GDP and the interbank rate.

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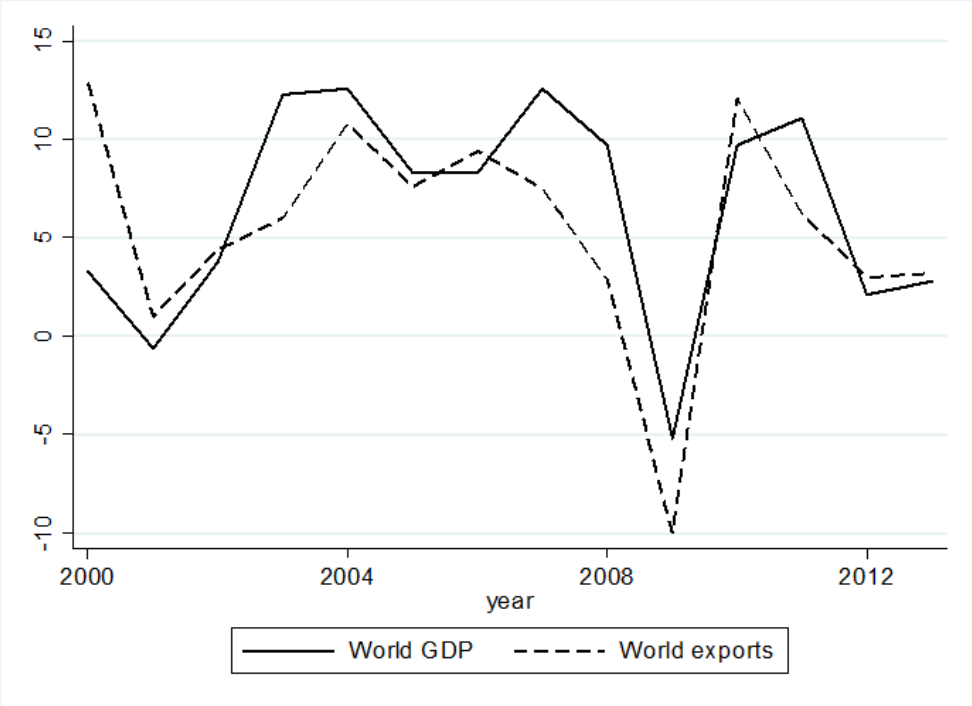
1. Introduction

After the financial crisis of 2008, international trade collapsed by around 30 percent. Figure 1 illustrates that the decline in world exports was twice as large as the decline in world gross domestic product (GDP). Because the decline in trade was much larger than the decline in GDP, it is often referred to as the Great Trade Collapse (Baldwin, 2009). The main driver of this collapse was the decrease in income and subsequently the decrease in demand. However, existing macroeconomic models mainly focusing focus on the decline in income as determinant of the trade collapse can only explain around 70 to 80 percent of the decline in international trade (Ahn, Amiti, & Weinstein, 2011).

Figure 1. Growth of world GDP and world exports



Source: World Bank World Development Indicators (2017)[1] for World GDP and Organization for Economic Coordination and Development (2017)[2] for world exports of goods.

In search of the missing 20 to 30 percent, two factors are pointed out as the missing link. Namely, global supply chains and trade finance. This paper focuses on the latter. Trade finance refers to the loans that exporters need in order to cover the period between shipment of the goods and receiving payment. During the 2008 financial crisis, the sharp rise in the cost of credit especially

[1] data.worldbank.org

[2] www.oecd-ilibrary.org

hurt exporters, as they depended heavily on external finance (Broll & Jauer, 2015). Exporters rely more on trade finance than non-exporters because of higher risk of default involved in the longer transaction processes and higher working capital requirements (Ahn, Amiti & Weinstein, 2011; Chor & Manova, 2012). However, whereas some research provide evidence for the role of trade finance and credit conditions during the 2008 crisis (Chor & Manova, 2012; Auboin & Engemann, 2014), Bricognge et al. (2012) stress the importance of the decline in income instead. Broll and Jauer (2015) further find that a financial crisis has a negative effect on exporters, and this effect is even stronger for differentiated goods. A possible explanation for this strong negative effect is that differentiated goods rely more on trade finance than homogenous goods. However, this hypothesis put forward by Broll and Jauer (2015) has not been tested empirically and therefore the research question of this paper is:

How does the cost of trade finance affect exports of homogenous and differentiated goods?

The structure of this paper is as follows. Section 2 describes the relevant literature on the effect of financial crises on trade. Section 3 discusses a theoretical model relating trade finance to exports of homogenous and differentiated goods. Based on this literature review and the theoretical model, several hypotheses are formulated, which form the basis of the empirical part of this paper. Section 4 describes the data for the empirical estimation and section 5 discusses the methodology. Section 6 gives the results of the estimation, and robustness checks are performed in section 7. Finally, the conclusion is given in section 8.

2. Literature review

2.1 Theoretical causes of the trade decline

There is not one clear-cut cause of the large decline in trade after the financial crisis of 2008. Several factors contributed to it, and the importance of each factor is still debated. Nevertheless, there is a general consensus about the channels through which the financial crisis affected trade. The 2008 financial crisis led to a large decrease in income, and this translated into an even larger decrease in trade (Broll & Jauer, 2015). However, there was a heterogeneous impact on trade in manufactures and services. This is due to the composition of exports and GDP. Exports mainly consist of durable goods, whose consumption can be postponed (Bricongne et al., 2012). In times of crisis and uncertainty, these goods are consumed less. A greater part of GDP, however, consists of services and consumable goods, which are necessary and cannot be

postponed (Ariu, 2016). As a result, exports are more volatile than GDP, which also explains why trade in services did not suffer from a similar collapse as trade in manufactures. The elasticity of service exports with respect to GDP growth was significantly different from that of goods exports during the crisis (Ariu, 2016). The effect of a decrease in income is theoretically analyzed by Eaton et al. (2016), who construct a multi-sector general equilibrium model. They measure economic activity as manufacturing durables, manufacturing non-durables, construction, and everything else (services). In their analysis, manufacturing output is the only tradable sector. Moreover, this analysis takes into account six different types of shocks, namely, shocks to the cost of trade in the manufacturing sectors, productivity in each sector, efficiency of investment in each type of capital, aggregate demand, demand for non-durable manufactures, and employment. Calibrating the relevant parameters, they find that the main cause of the decline in trade was the decline in efficiency of investment in durable manufactures, confirming the hypothesis that the composition of trade is the most important factor. They do not find strong evidence that a tightening of trade credit had a major influence on the decline in exports (Eaton et al., 2016).

The relevance of trade finance as a determining factor is put forward by Ahn, Amiti, and Weinstein (2011), who state that exporters depend greatly on external finance because the delivery date and the payment date are sometimes several months apart state. The import and export prices of goods shipped by sea rose disproportionately more than the prices of goods shipped by air or by land. Furthermore, since trade over sea is highly affected by trade finance conditions, it could be an explanation of the trade collapse (Ahn, Amiti, & Weinstein, 2011). Curran and Zignago (2011) support this view and find that credit supply has a significant positive effect on exports. Furthermore, according to Bricongne et al. (2012), trade finance is important for trade because exporting entails important fixed costs, exporting is more risky than domestic transactions only, and exporting involves longer lags between production and shipment. Therefore, exporters need credit lines to maintain healthy cash flows, and the contraction in credit availability hurt exports during the 2008 financial crisis (Bricongne et al., 2012). Chor and Manova (2012) argue that a reduction in credit as seen during the crisis can have a severe impact on the producer's ability to produce and export.

Finally, a third factor is the fragmentation of production and vertical supply chains. Curran and Zignago (2011) provide evidence for the role of global supply chains in the trade collapse; intermediate goods were more strongly affected by the lack of trade credit than final goods.

Broll and Jauer (2015) repeat the argument that the internationalization of production chains is a significant driver of the trade collapse. When uncertainty is high, as during a crisis, firms adjust their inventory downwards (Ariu, 2016). On the other hand, services are not affected by inventory adjustments, which explains the relative mild impact of the crisis on trade in services (Ariu, 2016).

Concluding, the three abovementioned factors, decline in income and composition of exports, tightening of trade credit, and vertical supply chains, can all explain why services did not decline much, trade in non-durable goods declined rapidly, and trade in differentiated durable goods suffered the most during the 2008 financial crisis. The importance of each factor is thus an empirical question.

2.2 Empirical findings

Curran and Zignago (2011) find that trade in vertically specialized sectors was hit harder during the 2008 crisis and trade by developed countries also suffered more. They test the trade finance hypothesis by including credit supply as proxy for ease of access to finance into a gravity model, using fixed effects to control for the bilateral trade costs. Credit supply has a significant positive effect on exports, but that this effect was is smaller during the recent crisis of 2008. Additionally, the income effect is more important, with the coefficients for exporter and importer GDP being around 0.3 and the coefficients for exporter and importer credit supply being around 0.1. Based on these results, they conclude that trade finance only plays a minor role in the trade collapse and that the main drivers are the fall in income and fragmented production chains (Curran & Zignago, 2011).

Bricongne et al. (2012) reach a similar conclusion while studying French firm-level data in 2008 and 2009. Although credit constraints deteriorate the performance of financially vulnerable firms, it cannot explain the aggregate fall in trade, because the share of these firms is small. Besides, they find that the main drivers are the decline in income and product characteristics (Bricongne et al., 2012).

However, these results are challenged by Chor and Manova (2012), who find a strong impact of financial conditions on trade. Since a measure of trade financing cost is not available, Chor and Manova (2012) instead use interbank lending rates as measure of tightness of credit markets, since trade finance contracts are usually linked to the interbank rate (Ahn, Amiti, & Weinstein, 2011). Although it is an imperfect measure, the effect is biased downwards, therefore alleviating some endogeneity concerns. They further use industry-level data on external finance

dependence, access to trade credit, and asset tangibility as measures of financial vulnerability. Using a fixed effects model and monthly data on industry-level US imports from November 2006 until October 2009, they find that the interaction effect of a crisis dummy, the interbank rate, and the measure of financial vulnerability is significantly negative on imports. Countries with tight credit conditions export less in financially vulnerable sectors, and this effect is even stronger during crises. These results remain valid when controlling for domestic production, stressing the importance of financial conditions. Finally, imports would have fallen by 2.5 percent more if interest rates were maintained at their peak level in September 2008, indicating that easing credit conditions helped mitigating a part of the negative effect of the financial crisis on international trade (Chor & Manova, 2012).

Auboin and Engemann (2014) provide further evidence on the relationship between trade finance and trade. Using an extensive dataset on export credit insurance from Berne Union, the international trade association for investment and export credit insurers, they have arguably the closest approximation of trade finance compared to other papers (Auboin & Engemann, 2014). Additionally, since they consider the period 2005 until 2011, the period after the crisis is also covered. A two-stage regression and instrumentation are used to ensure exogeneity of insured trade credits and to measure its impact on quarterly aggregate imports. After controlling for the level of liquidity, aggregate demand, the real exchange rate, and a crisis dummy, they find a strong and significantly positive impact of the lag of short-term trade credit on real imports. A 1 percent drop in insured trade credit decreases imports by 0.4 percent, and this effect is robust also in normal times. This indicates that the 27.8 percent reduction in insured trade credits during the crisis reduced imports by 11 percent (Auboin & Engemann, 2014). The effect of insured trade credits is only slightly smaller than the effect of real GDP, where the import elasticity is around 0.5. Additionally, a financial crisis leads to a reduction in imports by around 15 percent (Auboin & Engemann, 2014).

Finally, Broll and Jauer (2015) analyze the effect of a financial crisis on trade using an extensive gravity model, covering 200 exporting countries from 1950 to 2009. They use this large range of data to test for a different effect of ‘normal’ financial crises and the 2008 crisis. Using a dummy variable for a banking crisis, they find that when controlling for the level of economic development, a crisis negatively affects imports (Broll & Jauer, 2015). The size of this effect is around 27.1 percent, whereas the effect on differentiated goods is significantly larger, 32.4 percent. Furthermore, when splitting the dummy crisis variable into previous financial crises and the recent financial crisis, the effect of the recent crisis becomes even more pronounced. Differentiated goods are affected more negatively as they are more demanding in terms of trade

finance. Additionally, they find that developed countries are more affected than emerging economies, because differentiated goods take up a larger share of exports for the former (Broll & Jauer, 2015).

2.3 Conclusion of the literature

Concluding, the consensus is that the decline in income is the main driver of the trade collapse, but the effect of trade finance is still debated. Furthermore, the vertical specialization hypothesis also seems to play an important role. Curran and Zignago (2011) analyze the effect of credit supply on exports, but they do not consider the cost of trade finance. Instead, they use a crude measure of credit supply, namely total supply of private credit in the economy. Furthermore, they show that trade in intermediate goods declined more during the 2008 crisis, although they do not formally test the cause of this heterogeneous decline. Chor and Manova (2012) approximate the cost of trade finance by the interbank lending rate, to analyze its effect on imports. However, they do not consider different types of products. The same applies to Auboin and Engemann (2014), who use a insured trade credit as measure of trade finance. Finally, Broll and Jauer (2015) show that a banking crisis affects differentiated goods more than total exports. However, they do not show empirically whether this is caused by trade finance, but only suggest it as an explanation.

3. Theoretical model

3.1 Set-up Melitz model

The effect of a financial crisis on exports of homogenous and differentiated goods is theoretically analyzed by Manova (2013), based on the model by Melitz (2003). This paper also builds on the Melitz (2003) model by including liquidity constraints in the same way as in Manova (2013), the only difference is that this paper does not distinguish between different sectors in the economy, whereas Manova (2013) does account for several sectors. The model in this paper is thus a more simple and general model, although the conclusions from Manova (2013) still hold.

Consumers have Dixit-Stiglitz preferences, meaning they appreciate variety of goods (Dixit & Stiglitz, 1977). The utility function of the representative consumer is $U = \left(\int_{\omega\in\Omega} q(\omega)^{\rho}\, d\omega\right)^{\frac{1}{\rho}}$, where $0 < \rho < 1$ and ω is the index of varieties. Total expenditure per unit of utility with infinitely many varieties is $P = \left(\int_{\omega\in\Omega} q(\omega)^{1-\sigma}\, d\omega\right)^{\frac{1}{1-\sigma}}; \sigma = \frac{1}{1-\rho}; \sigma > 1$. Using Shephard's

lemma, the demand for a single variety per unit utility is given by the derivative of P with respect to the price of that variety. $\frac{\partial P}{\partial p(\omega)} = P^{\sigma} p(\omega)^{-\sigma}$. The total demand for a single variety is $q(\omega) = UP^{\sigma} p(\omega)^{-\sigma}$, where $U \equiv Q$ or $q(\omega) = IP^{\sigma-1} p(\omega)^{-\sigma}$, where $I \equiv PQ$, total expenditures. Revenue per variety is then $r(\omega) = IP^{\sigma-1} p(\omega)^{1-\sigma}$.

There are infinitely many firms, which all produce differentiated goods and they only differ in the variety they produce and their productivity. On the production side, $q = l \times \phi$, where l is the units of labor used, and ϕ is a productivity parameter, ranging from $\underline{\phi}$ to $\overline{\phi}$. Every firm faces f fixed costs, in terms of units of labor. If w is the wage, total costs amount to $TC = wf + w\frac{1}{\phi}q$ and marginal costs are $MC = \frac{w}{\phi}$. Revenues are $r(\phi) = I^{\frac{1}{\sigma}} P^{\frac{\sigma-1}{\sigma}} q(\phi)^{\frac{\sigma-1}{\sigma}}$ and marginal revenues are $MR = p(\phi)\left(1 - \frac{1}{\sigma}\right)$. Since firms are assumed to maximize profits, equalization of marginal revenues and marginal costs leads to $p(\phi) = \frac{\sigma}{\sigma-1}\frac{w}{\phi}$. A higher productivity leads to a lower price. Without changing the conclusions, the wage is normalized to one, such that $p(\phi) = \frac{\sigma}{\sigma-1}\frac{1}{\phi}$ and $c(\phi) = \frac{\sigma-1}{\sigma}p(\phi)$. Revenue is $r(\phi) = \left(\frac{\sigma}{\sigma-1}\frac{1}{\phi}\right)^{1-\sigma} IP^{\sigma-1}$. Profit is given by $\pi(\phi) = p(\phi)q(\phi) - c(\phi)p(\phi) - f$, which simplifies to $\pi(\phi) = \frac{r(\phi)}{\sigma} - f$. Since revenues increase in productivity, more productive firms have higher profits.

Aggregation gives the price index $P = \left(\int_{\underline{\phi}}^{\overline{\phi}} p(\phi)^{1-\sigma} N\mu(\phi)d\phi\right)^{\frac{1}{1-\sigma}}$. N is the total number or mass of firms, and $\mu(\phi)d\phi$ is the distribution of firms on the interval $[\underline{\phi}, \overline{\phi}]$. Simplifying the price index gives $P = N^{\frac{1}{1-\sigma}}\frac{\sigma}{\sigma-1}\frac{1}{\tilde{\phi}}$, with $\tilde{\phi} = \left(\int_{\underline{\phi}}^{\overline{\phi}} \mu(\phi)\phi^{\sigma-1}d\phi\right)^{\frac{1}{1-\sigma}}$ being average productivity.

There is free entry and exit in the market, entrants need to pay entry fixed costs f_e and each firm faces a negative shock with probability θ. If a firm is hit by the negative shock, it exits the market. Only firms with positive expected profits will start production upon entrance, so that the cut-off point is $\pi(\phi^*) = \frac{r(\phi^*)}{\sigma} - f = 0$. Firms with productivity below ϕ^* will not enter the market.

3.2 Introduction of financial constraints

If a firm wants to export, it faces several costs. There is a fixed cost f_x, which can be thought of as establishing and maintaining a sales office or network abroad. Furthermore, there are iceberg transport costs τ, meaning if $q(\phi)$ units are exported, $\frac{q(\phi)}{\tau}$ units arrive. τ are thus

marginal costs for exports. Until this point, the model is identical to the Melitz (2003) model. However, exporting firms also face liquidity constraints. This part of the model is taken from Manova (2013) and is only slightly modified. A fraction d of f_x needs to be paid at the beginning of each period and the firm has to attract external capital for this. The amount to be borrowed is thus df_x. The difference with Manova (2013) is that d is the same for every firm and does not differ per sector. Additionally, the fixed export costs are assumed to be the same for each destination country, but accounting for heterogeneous fixed costs would not change the results. To be able to borrow the required capital, the firm needs to pledge collateral, a fraction t of the entry fixed costs f_e. The probability of repayment depends on the level of financial development in a country and is given by $\lambda_j \in (0,1)$, where a higher λ indicates a higher level of financial development and thus a higher probability of repayment. When the contract is enforced, the repayment equals $F(\phi)$. The probability of default is $(1-\lambda_j)$ and in this case the investor takes the collateral. Firms maximize profits by optimizing

$$\pi_x(\phi) = p_x(\phi)q_x(\phi) - q_x(\phi)\tau c_x(\phi) - (1-d)f_x - \lambda_j F(\phi) - (1-\lambda_j)tf_e$$

subject to

$$(1.1)\ q_x(\phi) = p_x(\phi)^{-\sigma} I_x P_x^{\sigma-1}$$

$$(1.2)\ A(\phi) \equiv p_x(\phi)q_x(\phi) - q_x(\phi)\tau c_x(\phi) - (1-d)f_x \geq F(\phi)$$

$$(1.3)\ B(\phi) \equiv -df_x + \lambda_j F(\phi) + (1-\lambda)tf_e \geq 0$$

Condition (1.1) gives the formula for the quantity as derived above. (1.2) states that net revenues should be equal to or larger than the amount to be repaid. (1.3) gives the condition for investors, their return should not be less than the market return, which is normalized to 0 in this model. Because investors break even in competitive markets, firms will adjust the repayment such that $B(\phi) = 0$. Without the liquidity constraint binding, the firms produce and earn the following:

$$p_x(\phi) = \frac{\sigma}{\sigma-1}\frac{\tau}{\phi}$$

$$q_x(\phi) = \left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{-\sigma} P_x^{\sigma-1} I_x$$

$$r_x(\phi) = \left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1-\sigma} P_x^{\sigma-1} I_x$$

$$\pi_x(\phi) = \left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi}\right)^{1-\sigma} \frac{P_x^{\sigma-1} I_x}{\sigma} - f_x = \frac{r_x(\phi)}{\sigma} - f_x$$

3.3 Results with binding liquidity constraints

One can easily confirm that with the exception of additional transport costs τ and different fixed costs f_x, the results are identical to the ones presented above.

The interesting case of course is when liquidity constraints are binding. $B(\phi) \equiv -df_x + \lambda F(\phi) + (1-\lambda_j)tf_e = 0$, thus

$$F(\phi) = \frac{df_x - (1-\lambda_j)tf_e}{\lambda_j}$$

$$A(\phi) \equiv \left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi^*}\right)^{1-\sigma}\frac{P_x^{\sigma-1}I_x}{\sigma} - (1-d)f_x \geq \frac{df_x - (1-\lambda_j)tf_e}{\lambda_j}$$

$$r_x(\phi) = \left(\frac{\sigma}{\sigma-1}\frac{\tau}{\phi^*}\right)^{1-\sigma}P_x^{\sigma-1}I_x = \left(1-d+\frac{d}{\lambda_j}\right)f_x\sigma - \frac{(1-\lambda_j)}{\lambda_j}tf_e\sigma$$

Rewriting to give an expression for ϕ^*, the cut-off point is:

$$\phi^* = \left(\frac{\sigma}{\sigma-1}\tau\right)^{-1}P_x I_x^{\frac{1}{1-\sigma}}\left[\left(1-d+\frac{d}{\lambda_j}f_x\sigma\right) - \left(\frac{1-\lambda_j}{\lambda_j}tf_e\sigma\right)\right]^{\frac{1}{\sigma-1}}$$

$\frac{\partial\phi^*}{\partial\lambda_j} < 0$ if the loan exceeds the collateral, which is the natural case. A firm would not obtain a loan and pledge collateral if the firm can use the collateral to fully fund its operations. A higher level of financial development leads to a lower cut-off point, meaning more firms are active as exporters.

$\frac{\partial\phi^*}{\partial d} > 0$. This indicates that higher borrowing requirements lead to a higher cut-off point and fewer exporting firms.

$\frac{\partial\phi^*}{\partial t} < 0$, meaning if the collateral is higher, the cut-off point is lower, leading to more exporting firms. Firms can more easily obtain a loan from an investor if they pledge a high collateral. The reader should note that the collateral does not depend on productivity, so it concerns all firms. If the collateral is high, investors will provide loans to many firms, also with a relatively low productivity, there is thus a lower cut-off point. On the other hand, if the collateral is low, investors will only choose firms with a high enough productivity level, so that they can still expect repayment.

Concluding, investors are more prepared to invest in firms when the probability of repayment (λ) is high, when the upfront loan (df_x) is smaller, and when the collateral (tf_e) is higher. In a financial crisis, the default rate increases, there are higher borrowing requirements and firms can pledge less collateral, therefore fewer firms export. The effect on total exports is given by

aggregating all firms' export quantities, where M_{ij} is the total value of exports from country *j* to country *i*. Since only firms with a productivity level above the cut-off point ϕ^* will export, total exports are given by:

$$M_{ij} = \left(\frac{\tau}{\phi}\right)^{1-\sigma} P_x^{\sigma-1} I_x N_j \int_{\phi^*}^{\bar{\phi}} \phi^{1-\sigma} \mu(\phi) d\phi$$

$$\frac{\partial M_{ij}}{\partial \phi^*} = \left(\frac{\tau}{\phi}\right)^{1-\sigma} P_x^{\sigma-1} I_x N_j (-\phi^{1-\sigma}) < 0$$

3.4 Hypotheses

A higher cut-off point leads to fewer exporting firms, and thus lower exports. Furthermore, since $\frac{\partial \phi^*}{\partial \lambda_j} < 0$, $\frac{\partial \phi^*}{\partial d} > 0$, and $\frac{\partial \phi^*}{\partial t} < 0$, $\frac{\partial M_{ij}}{\partial \lambda_j} > 0$, $\frac{\partial M_{ij}}{\partial d} < 0$, and $\frac{\partial M_{ij}}{\partial t} > 0$. Financial development and higher collateral increases exports, whereas higher borrowing requirements decrease exports. Financial development relates to credit conditions, the higher financial development, the better credit conditions. Credit conditions in turn relate to the interbank rate, this paper's measure of the cost of trade finance. This leads to the first hypothesis of this paper:

H_1: The cost of trade finance has a negative effect on exports.

Furthermore, assuming $\sigma \ln(I_x) - \sigma \ln(\sigma) - 1 > 0$, which is reasonable because expenditures are of a different order of magnitude than the degree of product differentiation, $\frac{\partial^2 M_{ij}}{\partial \lambda_j \partial \sigma} > 0$. An increase in financial development thus has a larger effect on exports for differentiated products. Similarly, a decrease in financial development, an increase in the cost of trade finance, leads to a larger decline in exports for differentiated goods than for homogenous goods. The second hypothesis is thus:

H_2: The cost of trade finance has a larger effect on the exports of differentiated goods than on homogenous goods.

Additionally, because the cost of trade finance is assumed to have a negative effect on exports, and exports declined rapidly during the recent financial crisis, it is worth investigating whether the cost of trade finance has an even larger effect during a banking crisis, leading to the third and final hypothesis of this paper.

H_3: The effect of the cost of trade finance on exports is larger during a banking crisis.

4. Data

4.1 Measure of trade finance: interbank rate

Chor and Manova (2012) use the 30-day interbank lending rate as measure of the cost of trade finance. They acknowledge that this is imperfect, because the interest rate charged on export insurance or export credit would be more accurate. Since this data is not available for most countries, they argue that an overall cost of external finance would be a close approximation. The interbank rate is the interest charged by commercial banks on short-term loans (Chor & Manova, 2012). For exporters, the time frame between shipping goods and receiving payment is often one to three months. Therefore, they require a short-term loan to cover this gap. In this way, the interbank rate closely reflects the interest rate exports face, because it concerns short-term loans. The 30-day rate is appropriate for abovementioned reasons. Furthermore, during the 2008 financial crisis, the interbank rate was strongly correlated with the level of financial stress, signifying credit conditions on financial markets. Chor and Manova (2012) also argue that the interbank rate leads to a downward bias for three reasons. First, measurement error would induce bias towards zero. Second, this interest rate only reflects the cost of credit on transactions that actually took place. Transactions that did not take place would likely have faced even higher interest rates. Finally, during the 2008 crisis credit tightening became apparent by an increase in the cost of credit and by credit rationing. Therefore, the interbank rate captures both effects on credit rationing, and in combination with the first two reasons, it is biased downwards, which makes it harder to find a significant effect and the coefficient on the interbank rate will be lower thereafter, thus this estimate will be a lower bound (Chor & Manova, 2012).

Endogeneity concerns are mild with the interbank rate. Naturally, a recession and credit crunch will lead to a higher interbank rate, but this is accounted for by including GDP in the regression. Additionally, reverse causality, a specific case of endogeneity, is highly unlikely in this case. Suppose the decrease in exports was completely due to the decrease in demand. The demand for export credit would thus decrease, leading to a lower cost of credit. Since the interbank rate spiked when exports fell, this line of reasoning would not apply, alleviating concerns about reverse causality.

In general, the interbank rate is a good approximation of the overall cost of credit in the economy, unlikely to be related to unobservable factors also influencing exports, and it provides a lower bound of the estimated effect. Furthermore, Amiti, Ahn, and Weinstein (2011) also state that the cost of trade finance follows the interbank rate closely.

4.2 Measure of trade finance: insured trade credit

On the other hand, Auboin and Engemann (2014) use short-term insured trade credit of export credit agencies and export credit insurers, which is available for almost 100 countries from 2005 onwards. This dataset is provided by the Berne Union, the international trade association for credit and investment insurers. They use short-term trade credit, because 80 percent of total insured credit is short-term, and because it is consistent with the average time period between shipping goods and receiving payment. There can be reverse causality between exports and trade credit insurance. If exports decrease for another reason, exporters need less export insurance. This would seriously bias the results, therefore the authors apply an instrumentation technique. Since trade credit is influenced by economic and financial conditions, the first-stage regression includes GDP, money supply, and share of short-term claims paid. The latter is a measure of actual risk and its second lag is the instrument for the first lag of insured trade credit. A second instrument is the second lag of M1, which includes currency and deposits that are convertible to cash quickly and measures the level of liquidity in the economy. Liquidity is likely to be correlated with short-term insured credit, but unlikely to be correlated with imports. A regression of the logarithm of real imports on the instruments and other control variables shows that liquidity and the share of claims paid do not have a direct effect on real imports. Their first-stage regression shows that when using two stage least squares (2SLS) and random effects instrumental variables (RE IV), the instruments have a significant effect on the logarithm of short-term trade credit. The F-statistics are large, but the size of the coefficient on short-term claims paid per credit is relatively small. The argument given by the authors is that in times of increased risk, export insurers support their clients. Even if this argument is valid, it still casts doubt on the validity of the instrument. Furthermore, when fixed effects instrumental variables (FE IV) are used, the logarithm of M1 turns insignificant. In the FE IV specification the F-statistic does not surpass the threshold value of 10 (Staiger & Stock, 1997). A weak instrument can lead to worse results than OLS (Wooldrigde, 2016). The *plim* of the coefficient under OLS and under IV is as follows.

$$plim(\hat{\beta}_{OLS}) = \beta + Corr(x,u)\frac{\sigma_u}{\sigma_x}$$

$$plim(\hat{\beta}_{IV}) = \beta + \frac{Corr(z,u)}{Corr(z,x)}\frac{\sigma_u}{\sigma_x}$$

A weak instrument means that $Corr(z,x)$ is very low. If the latter part of the formula for IV becomes larger than latter part of the formula for OLS, OLS is more consistent than IV. However, this is not a problem when $Corr(z,u)$ is very small, so when the instrument is

exogenous. Since the authors show that the instruments do not have a direct effect on real imports other than through insured trade credit, and since they control for real GDP, the main driver of both short-term insured credit and real imports, the instruments seem valid.

4.3 Measures of trade finance: selection

Regarding the segment of international trade that uses credit insurance, the measure proposed by Auboin and Engemann (2014) would be most appropriate. Total insured credit by Berne Union in 2008 was around $1 trillion, whereas world exports of goods and services were $20 trillion. The Berne Union data thus only captures 5% of total trade. Moreover, the Berne Union data starts in 2005, which would be sufficient to cover the recent financial crisis, but does not allow for a larger time frame. The interbank rate is available for a much longer time and the effect of previous crises can thus also be tested. Therefore, this paper uses the interbank rate, as proposed by Chor and Manova (2012). Because of reasons mentioned above, the effect interbank rate is biased downwards (in absolute value). Additionally, since the interbank rate is mainly driven by the general state of the economy and the financial sector, and since this is accounted for in the regression, endogeneity should not be a strong concern. Furthermore, the interbank rate represents the cost of credit in the entire economy, and was especially important during the crisis. The possibility of reverse causality is also ruled out, as shown above. Finally, even if reverse causality exists, the impact would be minimal, since the interbank rate is used for all sorts of loans, mostly for domestic purposes. Since export credit is related to international activity, it is thus likely to take up only a small share of total credit, resulting in a minimal effect on the interbank rate.

4.4 Data sources

Since this paper comes close to the one by Broll and Jauer (2015) in terms of empirical specification, this paper uses the same data as they do to a large extent. The gravity equation in its basic form requires bilateral trade data, size of GDP for both countries, and a measure of trade costs (Head & Mayer, 2013). However, since there are no comprehensive measures of trade costs, many variables that influence exports, including common language, colonial history, distance and common border, etc., are obtained from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)[3]. Bilateral trade data are obtained from the UN

[3] www.cepii.fr

Comtrade database[4], which also reports the product categories. The product classification used is the four-digit SITC second revision classification. These data are then classified into homogenous and differentiated goods, using the classification of Rauch (1999). Rauch (1999) distinguishes between a conservative and a liberal classification of differentiated goods. Although they are strongly correlated ($r = 0.83$), this paper tests if different classifications change the results significantly. Data on GDP are obtained from the IMF World Economic Outlook Database. The timing of financial crisis is obtained from Reinhart and Rogoff (2011)[5], who provide data on banking crises. Following Chor and Manova (2012), data on the interbank rates, proxy for the cost of trade finance, are obtained from the Thomson Datastream. Several countries have more than one interbank rate available, in that case the one reported by the central bank or other banking authority is chosen. Annual real effective exchange rates from 1992 are obtained from the Bruegel think tank database composed by Darvas (2012)[6].

4.5 Sample selection

The total sample ranges from 1980 to 2016, to ensure a large sample size that not only focuses on recent years. However, the sample is unbalanced, because not every country has trade data or interbank rate data available from 1980. The selection of origin, or exporting, countries in the sample hinges on a few conditions. First, availability of bilateral trade data on the product category level is necessary, because it is the dependent variable. Second, data on the interbank rate are required, since that is the main independent variable. However, for some countries, the data are only available for a few years. A minimum requirement is that the first year available is 2007 or earlier. 2007 is chosen so that there is at least one year of data before the financial crisis started. As a result, 53 origin countries and 256 destination countries are used. Trade relationships are omitted when the destination is not a country, but a general area, such as Asia, Oceania and Other Africa as there can be no measurement of several gravity variables. In total, the sample consists of 234,095 bilateral trade relations. However, gravity variables are only available for 219,404 relations. Additionally, the one-month interbank rate is reported 195,477 times. Inclusion of banking crisis dummies for origin countries reduces the sample size even further, since it is available for only 148,055 relations. One drawback from the crisis data by Reinhart and Rogoff (2011) is that it only reaches until 2010. Another factor limiting the sample

[4] comtrade.un.org

[5] www.carmenreinhart.com

[6] bruegel.org

size is the availability of the real exchange rates, therefore, in most models the sample ranges from 1992-2010.

4.6 Data description

The summary statistics in table 1 show that on average, 66% of total trade in goods is trade in differentiated goods, with the conservative classification. Some countries do not trade with each other, whereas the maximum is almost 400 billion USD worth of trade. One could argue that the origin and destination, or importing, countries in the sample are very different, since the mean size of GDP is almost 3.5 times higher for origin countries. As explained above, origin countries are chosen as a result of data availability, and in general more developed countries have better statistical offices, hence more data availability. One interesting feature is the discrepancy between the number of observations for crisis dummies in origin and destination countries. 38 origin countries and 70 destination countries have crisis dummies. If an origin country has data for a crisis dummy in a certain year, it can occur at most 255 times, because it will have an observation for each destination country. On the other hand, if a destination country has data for a crisis dummy in a certain year, it can have at most 53 observations, the maximum number of origin countries. This explains why the number of observations for crisis dummies in destination countries is lower.

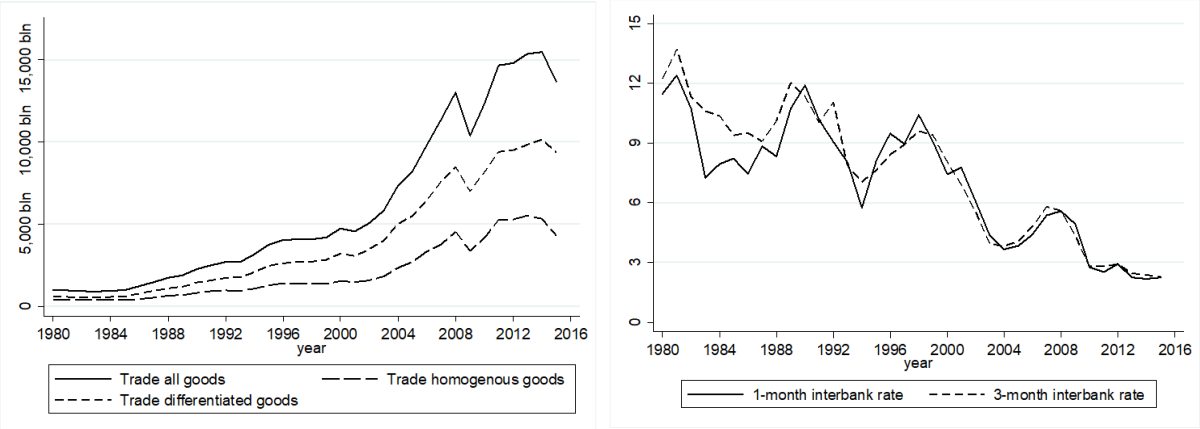
Figure 2 below shows how trade rapidly increased in the early 2000s, but was hit hard by the financial crisis in 2009. In 2009 the crisis led to a reduction in total trade by 20%. Trade in homogenous and differentiated goods decreased by 25.4 and 17.5 percent, respectively. However, in 2011 total exports already exceeded its peak level of 2008, only to stagnate from 2012 onwards. The rapid increase in trade from 2000 onwards coincides with a fall in the interbank rate. Additionally, in 2008 and 2009 the interbank rate was at a temporary peak, whereas trade declined rapidly. After 2009, when the main central banks lowered interest rates and started quantitative easing, the interbank rate decreased and trade picked up again. These graphs indicate there is likely a relationship between the interbank rate and trade. However, the graphs hide the heterogeneity between countries, so the true effect may be different from what the graph shows.

Table 1. Descriptive statistics

Variable	Obs.	Mean	Std. dev.	Min	Max
Exports (mln USD)	232,827	851	6,460	0.000001	399,000
Exports differentiated goods (con; mln USD)	232,827	561	4,650	0	355,000
Exports differentiated goods (lib; mln USD)	232,827	518	4,270	0	345,000
Exports homogenous goods (con; mln USD)	232,827	290	2,170	0	190,000
Exports homogenous goods (lib; mln USD)	232,827	333	2,540	0	196,000
1-month interbank rate	194,437	5.22	6.52	-1.00	103.82
3-month interbank rate	223,779	5.82	6.42	-0.76	83.79
GDP_i (bln USD)	232,176	994.00	2,143.94	5.60	18,036.65
GDP_j (bln USD)	199,947	285.31	1,178.23	0.01	18,569.10
Banking $crisis_i$	147,278	0.18	0.39	0	1
Banking $crisis_j$	63,946	0.19	0.39	0	1

Source: UN COMTRADE, IMF World Economic Outlook, Thomson Datastream, Reinhart and Rogoff (2011), and author's calculations. Subscript *i* and *j* refer to the exporting and importing country, respectively.

Figure 2. Exports and interbank rates



Source: UN COMTRADE, Thomson Datastream, and author's calculations.

The correlation between exports and the interbank rate is relatively small, but significant, and a banking crisis is positively related to an increase in the interbank rate. All correlations are significant at the 5 or 1 percent level. The descriptive statistics point towards a negative

relationship between the interbank rate and exports, although the interbank rate has a virtually identical correlation with homogenous and differentiated exports. The next section describes the methodology to establish a causal relationship between the interbank rate and exports.

Table 2. Correlation coefficients

	Trade	**Trade hom. (con)**	**Trade dif. (con)**	**1-month ibr**	**3-month ibr**
Trade	1				
Trade hom. (con)	0.911	1			
Trade dif. (con)	0.985	0.828	1		
1-month ibr	-0.023	-0.021	-0.023	1	
3-month ibr	-0.025	-0.023	-0.025	0.978	1
Banking crisis origin country	0.007	0.007	0.006	0.151	0.165

5. Methodology

The gravity equation states that the level of exports between two countries depends on the size of their economies, their bilateral distance, and on trade costs (Head & Mayer, 2013). In its structural form, the gravity equation looks as follows:

$$X_{ij} = \frac{Y_i Y_j}{Y_w}\left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}$$

X_{ij} are exports from country *i* to country *j*, Y_i and Y_j is the GDP for country *i* and *j*, respectively. t_{ij} is a measure of the trade costs, and Π_i and P_j are the multilateral resistance terms (Anderson & Van Wincoop, 2003). The multilateral resistance terms are barriers to trade between a country and all its trading partners, they are defined as:

$$\Pi_i = \left[\sum_i \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} \theta_j\right]^{\frac{1}{1-\sigma}}$$

$$P_j = \left[\sum_i \left(\frac{t_{ij}}{\Pi_j}\right)^{1-\sigma} \theta_i\right]^{\frac{1}{1-\sigma}}$$

The multilateral resistance terms cannot be measured, but they are modeled by specifying import and export country time-varying effects (Head & Mayer, 2013). However, when fixed effects are used, some variables of interest cannot be included, because they are time-invariant

and including them would require dropping one or more country dummies, making the estimates meaningless (Head & Mayer, 2013).

After constructing the gravity equation with all relevant variables, the logarithm is applied to estimate the equation:

$$\ln(X_{ij}) = \ln(Y_i Y_j) - \ln(Y_w) + (1-\sigma)\ln(t_{ij}) - (1-\sigma)\ln(\Pi_i P_j)$$

Trade costs t_{ij} are approximated by bilateral distance (d_{ij}) and a dummy variable for a common border (b_{ij}). This baseline model is extended by including other variables that affect trade costs, such as common language, regional trade agreements, common currency, and most importantly for this paper, the cost of trade finance. ε_{ij} is the error term.

Finally, the specification of this paper is as follows:

$$\ln(X_{ijt}) = \beta_0 + \beta_1 \ln(Y_{it}) + \beta_2 \ln(Y_{jt}) + \beta_3 TF_{it} + \beta_4 BC_{jt} + \alpha_{ij} + \varepsilon_{ijt}$$

TF_{it} is the main variable of interest, it measures the cost of trade finance for the exporting country. It equals the 30-day interbank rate. The dummy variable BC_{jt} indicates whether the importing country suffered from a banking crisis in a certain period. α_{ij} is the country pair fixed effect, including all time-invariant country pair-specific factors that affect bilateral trade flows. In gravity models without fixed effects, variables such as distance, common border, or common language play an important role. However, when fixed effects are applied, all these bilateral time-invariant variables are absorbed by the fixed effects and therefore their coefficients cannot be estimated when fixed effects are used.

Furthermore, the main specification is tested for homogenous and differentiated goods separately, to see if the cost of trade finance has a heterogeneous effect, which is the second hypothesis.

$$\ln(XH_{ijt}) = \gamma_0 + \gamma_1 \ln(Y_{it}) + \gamma_2 \ln(Y_{jt}) + \gamma_3 TF_{it} + \gamma_4 BC_{jt} + \alpha_{ij} + \mu_{ijt}$$

$$\ln(XD_{ijt}) = \delta_0 + \delta_1 \ln(Y_{it}) + \delta_2 \ln(Y_{jt}) + \delta_3 TF_{it} + \delta_4 BC_{jt} + \alpha_{ij} + \eta_{ijt}$$

XH_{ijt} refer to exports of homogenous goods from country *i* to country *j* in year *t*, and XD_{ijt} the same for differentiated goods exports. μ and η are the respective error terms. The second hypothesis states that $\delta_3 > \gamma_3$ in absolute value.

Finally, the third hypothesis states that the effect of trade finance on exports is larger during banking crises. An interaction effect between trade finance and the dummy variable for a banking crisis in the origin country ($BC_{it}TF_{it}$) is used to test this hypothesis.

$$\ln(X_{ijt}) = \beta_0 + \beta_1 \ln(Y_{it}) + \beta_2 \ln(Y_{jt}) + \beta_3 TF_{it} + \beta_4 BC_{jt} + \beta_5 BC_{it} + \beta_6 BC_{it}TF_{it} + \alpha_{ij} + \varepsilon_{ijt}$$

6. Results

6.1 Effect of trade finance on total exports

Table 3 shows the results for the first hypothesis. In the models without fixed effects in the first two columns, trade finance has a small, but significant positive effect on exports, contrary to expectation. However, when fixed effects are included to account for all time-invariant country pair-specific variables, the effect becomes negative, indicating some unobservable variables have led to an upward bias of the estimate. A banking crisis in the destination country also has a negative effect on total exports, capturing the demand-side effects of a financial crisis. A domestic banking crisis does not have a significant effect on trade, although it does influence the coefficients on the interbank rate and GDP. The results below thus confirm the first hypothesis, although the coefficient is quite small. A one percentage point increase in the interbank rate leads to a decrease of exports by 1%. This should not be interpreted as elasticity, as trade finance is not transformed into a natural logarithm. On the other hand, the estimation shows that the elasticity of trade with respect to GDP is slightly larger for the destination country than for the origin country. A banking crisis in the destination country decreases exports by 4.5%. Broll and Jauer (2015) in their regressions with fixed effects find that a banking crisis in the importing country leads to a decrease in trade by approximately 1%.[7] The coefficient presented here is larger, but Broll and Jauer (2015) also find a larger elasticity of trade with respect to GDP, which can explain the difference. On the other hand, Curran and Zignago (2011) find a smaller elasticity to GDP for both the origin and destination country. However, they do find that the elasticity w.r.t. the GDP of the importing country has a larger effect than the GDP of the exporting country.

Although the dummy variable for a banking crisis in the origin country is not statistically significant, it is important to include it, because it is a source of bias. As explained above, during a banking crisis, the interbank rate increases, and GDP decreases. The coefficients for the interbank rate and GDP change substantially, therefore it is important to include the domestic crisis dummy. The negative effect of the cost of trade finance is confirmed by Auboin and Engemann (2014), who find that more insured credit stimulates trade. Finally, an appreciation of the real effective exchange rate leads to a decrease in exports, with an elasticity around 0.56. Inclusion of the real effective exchange rate is important, because it is generally established that an appreciation has a negative effect on exports, but the interbank rate can also influence

[7] Note that this estimate is smaller than the one of 27.1% mentioned above, but in terms of econometric specification the estimate of 1% result is more comparable to the finding in this paper.

exchange rates. A higher interbank rate leads to a capital inflow and more demand for the domestic currency, which translates into an appreciation of the exchange rate. A higher real effective exchange rate is thus positively correlated with the interbank rate, and negatively correlated with trade, meaning the coefficient in column (4) is biased downwards. Including the exchange rate in column (5) leads to a smaller coefficient in absolute terms.

Table 3. Baseline results

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
	Dependent variable: log of trade value					
1-month ibr	0.010***	0.003**	-0.004**	-0.003*	-0.006***	-0.010***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
GDP_i	0.691***	0.673***	0.539***	0.608***	0.935***	0.753***
	(0.014)	(0.021)	(0.033)	(0.046)	(0.078)	(0.069)
GDP_j	0.713***	0.668***	0.668***	0.647***	0.781***	0.786***
	(0.009)	(0.015)	(0.025)	(0.031)	(0.034)	(0.033)
Banking $crisis_j$		-0.047***	-0.050***	-0.047***	-0.034**	-0.045***
		(0.015)	(0.014)	(0.016)	(0.016)	(0.014)
Banking $crisis_i$						-0.006
						(0.015)
REER				-0.280***	-0.583***	-0.556***
				(0.090)	(0.114)	(0.106)
Gravity variables	Yes	Yes	No	No	No	No
Fixed effects	No	No	Yes	Yes	Yes	Yes
Year dummies	No	No	No	No	Yes	Yes
Observations	161370	47667	47667	43595	43595	33384
R^2	0.291	0.331	0.332	0.295	0.303	0.406

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Robust standard errors between brackets. The dependent variable is the natural logarithm of trade value. 1-month ibr stands for one-month interbank rate. GDP for both countries and the real effective exchange rate (REER) are also in logarithms. Gravity variables include the logarithm of bilateral distance, a border dummy, a colonial relationship dummy, a common colonizer dummy, and a same country dummy if the two countries were ever part of the same country. All regressions include a constant. Subscript *i* and *j* refer to the exporting and importing country, respectively.

Table 4. Homogenous and differentiated goods

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: trade value					
	Hom.	Hom.	Dif.	Dif.	Hom.	Dif.
1-month ibr	0.002	0.001	-0.006***	-0.006***	0.001	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Banking $crisis_j$	-0.009	-0.028	-0.060***	-0.055***	-0.030	-0.058***
	(0.017)	(0.018)	(0.016)	(0.016)	(0.018)	(0.016)
Banking $crisis_i$	-0.021	-0.023	-0.022	0.004	-0.019	0.002
	(0.018)	(0.019)	(0.016)	(0.016)	(0.019)	(0.016)
GDP_i	0.353***	0.681***	0.478***	0.854***	0.783***	0.795***
	(0.049)	(0.085)	(0.042)	(0.070)	(0.087)	(0.068)
GDP_j	0.712***	0.790***	0.749***	0.860***	0.815***	0.847***
	(0.036)	(0.044)	(0.030)	(0.035)	(0.043)	(0.035)
REER	-0.370***	-0.806***	-0.221**	-0.563***	-0.895***	-0.518***
	(0.098)	(0.125)	(0.097)	(0.115)	(0.126)	(0.115)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	No	Yes	No	Yes	Yes	Yes
Classification	Cons.	Cons.	Cons.	Cons.	Lib.	Lib.
Observations	34408	34408	34773	34773	34483	34758
R^2	0.240	0.248	0.366	0.376	0.264	0.374
Adjusted R^2	0.240	0.247	0.366	0.375	0.264	0.374

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Robust standard errors between brackets. The dependent variable is the natural logarithm of trade value of respectively homogenous and differentiated goods. 1-month ibr stands for one-month interbank rate. GDP for both countries and the real effective exchange rate (REER) are also in logarithms. Hom. and Dif. refer to homogenous and differentiated goods. Cons. and Lib. refer to conservative and liberal. All regressions include a constant. Subscript *i* and *j* refer to the exporting and importing country, respectively.

6.2 Effect of trade finance on homogenous and differentiated goods exports

In order to test the second hypothesis, the dependent variable is split into exports of homogenous and differentiated goods. Table 4 shows that the interbank rate does not have a significant effect on exports of homogenous goods. On the other hand, the coefficient in the regression with differentiated goods is significantly negative, translating into a 0.6% decrease

in exports if the interbank rate increases by 1 percentage point, a smaller effect than on total exports. This is found by using both the conservative and liberal classification. One would expect the coefficients on the interbank rate for total exports to lie between the coefficients on the interbank rate for homogenous and differentiated goods exports. Surprisingly, the effect on total exports is even larger. One explanation for this is the use of different sample sizes, because in table 3 the observations included are those who have the gravity variables, to compare it to the results from the models in column (1) and (2). The next section on robustness checks considers the models using the same sample size. Furthermore, if the destination country experiences a banking crisis, there is no significant effect on homogenous goods exports, but differentiated goods exports decline by 5.5%. This effect is larger for differentiated goods than for total exports. This confirms the finding by Broll and Jauer (2015) and the theoretical model described above, a banking crisis has a stronger effect on differentiated goods than on homogenous goods and on total exports. Finally, the elasticity of trade to GDP is much larger for differentiated goods, explaining why trade in differentiated goods declined more during the crisis.

6.3 Stronger effect of trade finance on exports during a financial crisis

The third hypothesis states that the effect of the cost of trade finance on exports is larger when the origin country experiences a banking crisis. The results in table 5 below do not confirm this hypothesis, since the interaction effect is significantly positive. The effect of the interbank rate on trade is thus smaller during crisis years, although the coefficient for the interbank rate is larger than in previous models. Furthermore, a domestic banking crisis decreases exports by around 5% for total exports and 6.7% for differentiated goods exports. This effect was absent in the models without an interaction effect.

7. Robustness checks

7.1 Three-month interbank rate

When the three-month interbank rate is used, instead of the one-month interbank rate, a strong effect on trade does not show, except for differentiated goods, as given in table 6 in the appendix. A reason for this is that perhaps trade finance contracts are more closely linked to the one-month interbank rate than the three-month interbank rate. Unfortunately, this cannot be tested. Another possibility is the influence of outliers. The mean three-month interbank rate is 5.8%,

but in some cases it is well over 50%, which is clearly an extreme case. The same applies to the one-month interbank rate, where the maximum is almost 104%.

Table 5. Interaction effect with banking crisis

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: trade value					
					Hom.	Dif.
1-month ibr	-0.003*	-0.003**	-0.008***	-0.009***	-0.002	-0.014***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Banking $crisis_j$	-0.033**	-0.035**	-0.030**	-0.035**	-0.029	-0.055***
	(0.014)	(0.015)	(0.014)	(0.014)	(0.018)	(0.016)
Banking $crisis_i$	-0.017	-0.000	-0.061***	-0.050***	-0.049**	-0.067***
	(0.013)	(0.015)	(0.016)	(0.018)	(0.022)	(0.020)
BC_i*1-month ibr			0.007***	0.007***	0.004**	0.010***
			(0.001)	(0.002)	(0.002)	(0.002)
GDP_i	0.433***	0.727***	0.403***	0.675***	0.654***	0.781***
	(0.039)	(0.067)	(0.040)	(0.069)	(0.087)	(0.070)
GDP_j	0.735***	0.816***	0.743***	0.816***	0.790***	0.860***
	(0.029)	(0.034)	(0.029)	(0.034)	(0.044)	(0.035)
REER	-0.245***	-0.555***	-0.189**	-0.474***	-0.765***	-0.448***
	(0.085)	(0.104)	(0.086)	(0.107)	(0.128)	(0.116)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	No	Yes	No	Yes	Yes	Yes
Observations	34879	34879	34879	34879	34408	34773
R^2	0.389	0.397	0.390	0.398	0.248	0.378
Adjusted R^2	0.389	0.397	0.390	0.398	0.248	0.377

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Robust standard errors between brackets. The dependent variable is the natural logarithm of trade value of respectively homogenous and differentiated goods. 1-month ibr stands for one-month interbank rate. GDP for both countries and the real effective exchange rate (REER) are also in logarithms. Hom. and Dif. refer to homogenous and differentiated goods, which are categorized according to the conservative classification by Rauch (1999). All regressions include a constant. Subscript *i* and *j* refer to the exporting and importing country, respectively.

7.2 Exclusion of outliers

Table 7 in the appendix shows how the exclusion of these extreme values influences the results. The models only include observations where the interbank rate was below 50%, so they still allow for extreme cases. When comparing the number of observations, the sample size for table 7 shrank only a little bit, indicating the high values of the interbank rate are indeed outliers. Furthermore, table 7 shows even stronger coefficients for the effect on differentiated goods exports, for the other models the results are not influenced. A one percentage point increase in the interbank rate decreases exports of differentiated goods by 1.1%, while it does not have a significant effect on homogenous goods exports. Additionally, the coefficient of the three-month interbank rate is now significant at the 10% level, whereas it was not significant when using the full sample. This further indicates that outliers influence the results in table 6. For the other models however, using the full or restricted sample does not qualitatively change the conclusions.

7.3 Lag effect of one-month interbank rate

The one-month interbank rate is appropriate because most trade contracts only cover a few months. However, for some long-term contracts the cost of trade finance may be closer to the interbank rate in the year before. Therefore, the first lag of the one-month interbank rate is included as a robustness check, as shown in table 8 in the appendix. When the lagged value is included, the coefficient on the contemporaneous value of the interbank rate turns insignificant, whereas the coefficient on the lagged interbank rate is significant in most cases and is similar in size to the coefficients found before. This is explained by the autocorrelation in the interbank rate ($r = 0.884$), therefore the last columns exclude the contemporaneous value, leaving the coefficients virtually unchanged. On the other hand, the coefficient in column (4) is smaller than the coefficient on the interbank rate in table 3 column (5), which is the main specification of this paper. The lack of significance in column (5) is unsurprising, because in the previous tables no significant effect on homogenous goods exports is found. The effect of the lagged one-month interbank rate on exports of differentiated goods is similar to the effect of the contemporaneous interbank rate.

7.4 Fixed sample size

The baseline results in section V are obtained using different sample sizes, which may lead to different coefficients. Table 9 in the appendix corrects for this by using the same sample size for each model. This leads to a smaller coefficient on the interbank rate for total exports, a 1

percentage point increase in the interbank rate leads to a 0.4% decrease in exports. For homogenous and differentiated goods, the coefficients are approximately similar to the results in table 4. Table 9 is also more conform the expectation that most coefficients in column (1) lie between the coefficients in column (2) and (3), since total exports is the sum of homogenous goods exports and differentiated goods exports. The results clearly show that differentiated goods exports are more severely affected by the cost of trade finance and banking crises than homogenous goods. This confirms the theoretical model and the results by Broll and Jauer (2015).

8. Conclusion

The aim of this paper is to analyze the effect of trade finance on exports. More specifically, this paper distinguishes between exports of homogenous and differentiated goods. Based on the existing literature, the theoretical model by Melitz (2003) and the extension of financial constraints by Manova (2013), the main hypothesis of this paper is that the cost of trade finance has a larger effect on differentiated goods exports than on homogenous goods exports. After running a fixed effects regression with the one-month interbank rate as measure of the cost of trade finance, this paper finds robust evidence that an increase in the cost of trade finance leads to a decrease in total exports. Depending on the sample used, this effect translates into a 0.4% to 1% decrease in total exports if the interbank rate is increased by 1 percentage point. The first hypotheses is thus accepted.

Furthermore, whereas homogenous goods exports are not affected by the interbank rate, differentiated goods exports are. A 1 percentage point increase in the cost of trade finance decreases differentiated goods exports by 0.6%, confirming the second hypothesis of this paper. The interbank rate also affects differentiated goods exports through a lag. This paper rejects the third hypothesis that the cost of trade finance has a stronger effect during banking crises. The literature suggests that another factor in the disproportionate decline in differentiated goods exports is a higher elasticity w.r.t. GDP and this paper presents robust evidence in favor of that hypothesis. Finally, a banking crisis in the origin country decreases total exports by 4.5%, but decreases differentiated goods exports by 5.5%.

There are three noticeable limitations in this research. The largest limitation is that this paper does not propose a theoretical model which explicitly incorporates the cost of trade finance. Instead, the three measures of financial constraints from Manova (2013) are used. Additionally, data after 2010 are not considered, because of the lack of reliable banking crisis data. Therefore

the long-run effects of the Great Recession cannot be analyzed. An extension of the classification of banking crises by Reinhart and Rogoff (2011) would not only be beneficial to this paper, but to a wide scope of research. Finally, the one-month interbank rate is a close approximation of the cost of trade finance, but it is still an approximation. A reliable dataset on the true cost of trade finance would enable researchers to provide more reliable estimates, because, as this paper shows, it is an important determinant of trade.

The policy implication of this paper is that financial conditions matter for trade. Furthermore, during an economic downturn trade in goods, and especially differentiated goods, can decline more than trade in other sectors, bringing those exporters into distress. A policy focused on alleviating credit conditions and reducing the cost of trade finance can be the solution to that problem, as the results in this paper show.

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10. Appendix

Table 6. Baseline results using the three-month interbank rate

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: trade value					
				Hom.	Dif.	
3-month ibr	-0.000	-0.002*	-0.003	0.002	-0.005***	-0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Banking $crisis_j$	-0.048***	-0.038**	-0.038***	-0.032*	-0.056***	-0.038**
	(0.013)	(0.012)	(0.012)	(0.015)	(0.014)	(0.012)
Banking $crisis_i$		-0.007	0.022	-0.025	0.029*	-0.009
		(0.014)	(0.015)	(0.020)	(0.016)	(0.018)
BC_i*3-month ibr						0.004***
						(0.002)
GDP_i	0.589***	0.417***	0.753***	0.756***	0.840***	0.728***
	(0.043)	(0.039)	(0.066)	(0.084)	(0.070)	(0.086)
GDP_j	0.667***	0.729***	0.816***	0.796***	0.857***	0.8169***
	(0.030)	(0.029)	(0.034)	(0.042)	(0.035)	(0.034)
REER	-0.284***	-0.178**	-0.535***	-0.826***	-0.508***	-0.489***
	(0.083)	(0.081)	(0.103)	(0.126)	(0.113)	(0.106)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	No	No	Yes	Yes	Yes	Yes
Observations	49192	38140	38140	37526	37971	38140
R^2	0.297	0.371	0.380	0.236	0.361	0.380
Adjusted R^2	0.297	0.371	0.380	0.236	0.360	0.380

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Robust standard errors between brackets. The dependent variable is the natural logarithm of trade. 3-month ibr stands for three-month interbank rate. GDP for both countries and the real effective exchange rate (REER) are also in logarithms. Hom. and Dif. refer to homogenous and differentiated goods, which are categorized according to the conservative classification by Rauch (1999). All regressions include a constant. Subscript *i* and *j* refer to the exporting and importing country, respectively.

Table 7. Baseline results using restricted sample size

	(1)	(2)	(3)	(4)	(5)
Corresponds to	Table 3-6	Table 3-7	Table 4-2	Table 4-4	Table 6-3
	Dependent variable: trade value				
			Hom.	Dif.	
1-month ibr	-0.006***	-0.010***	-0.000	-0.011***	
	(0.002)	(0.002)	(0.002)	(0.002)	
3-month ibr					-0.004*
					(0.002)
Banking crisis$_j$	-0.034**	-0.045***	-0.037**	-0.062***	-0.046***
	(0.016)	(0.014)	(0.018)	(0.016)	(0.014)
Banking crisis$_i$		-0.006	-0.030	0.000	0.020
		(0.015)	(0.019)	(0.016)	(0.015)
GDP$_i$	0.935***	0.753***	0.650***	0.834***	0.750***
	(0.078)	(0.069)	(0.086)	(0.070)	(0.068)
GDP$_j$	0.781***	0.786***	0.782***	0.843***	0.802***
	(0.034)	(0.033)	(0.044)	(0.035)	(0.034)
REER	-0.538***	-0556***	-0.731***	-0.562***	-0.524***
	(0.114)	(0.106)	(0.128)	(0.117)	(0.105)
Fixed effects	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes
Observations	43595	33384	34098	34447	37812
R^2	0.303	0.406	0.251	0.378	0.383
Adjusted R^2	0.303	0.405	0.251	0.378	0.383

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Robust standard errors between brackets. The dependent variable is the natural logarithm of trade. 1-month ibr stands for one-month interbank rate and 3-month ibr stands for three-month interbank rate. GDP for both countries and the real effective exchange rate (REER) are also in logarithms. Hom. and Dif. refer to homogenous and differentiated goods, which are categorized according to the conservative classification by Rauch (1999). All regressions include a constant. Only observations with a one-month respectively three-month interbank rate below 50% are included. Subscript *i* and *j* refer to the exporting and importing country, respectively.

Table 8. Lagged effect interbank rate

	(1)	(2)	(3)	(4)	(5)	(6)
	Dependent variable: trade value					
		Hom.	Dif.		Hom.	Dif.
1-month ibr	-0.001	0.000	-0.001			
	(0.001)	(0.002)	(0.001)			
1-month ibr(-1)	-0.003**	0.000	-0.007***	-0.004**	0.000	-0.007***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Banking $crisis_j$	-0.041***	-0.023	-0.060***	-0.041***	-0.023	-0.060***
	(0.015)	(0.019)	(0.016)	(0.015)	(0.019)	(0.016)
Banking $crisis_i$	-0.009	-0.038*	0.002	-0.010	-0.037*	0.001
	(0.015)	(0.019)	(0.017)	(0.015)	(0.019)	(0.017)
GDP_i	0.617***	0.546***	0.735***	0.619***	0.545***	0.736***
	(0.072)	(0.091)	(0.074)	(0.072)	(0.091)	(0.074)
GDP_j	0.821***	0.813***	0.856***	0.821***	0.813***	0.586***
	(0.035)	(0.045)	(0.036)	(0.035)	(0.045)	(0.036)
REER	-0.378***	-0.500***	-0.408***	-0.379***	-0.499***	-0.408***
	(0.111)	(0.139)	(0.123)	(0.111)	(0.139)	(0.123)
Fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
F-stat joint test ibr	2.73	0.04	11.18			
Observations	32775	32409	32705	32775	32409	32705
R^2	0.407	0.249	0.380	0.406	0.249	0.380
Adjusted R^2	0.406	0.248	0.380	0.406	0.248	0.380

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Robust standard errors between brackets. The dependent variable is the natural logarithm of trade. 1-month ibr stands for one-month interbank rate. GDP for both countries and the real effective exchange rate (REER) are also in logarithms. Hom. and Dif. refer to homogenous and differentiated goods, which are categorized according to the conservative classification by Rauch (1999). All regressions include a constant. Subscript *i* and *j* refer to the exporting and importing country, respectively.

Table 9. Baseline results corrected for sample sizes

	(1)	(2)	(3)
	Dependent variable: trade value		
		Hom.	Dif.
1-month ibr	-0.004***	0.000	-0.007***
	(0.001)	(0.002)	(0.002)
Banking crisis$_j$	-0.056***	-0.032*	-0.076***
	(0.014)	(0.018)	(0.016)
Banking crisis$_i$	-0.007	-0.026	0.002
	(0.014)	(0.018)	(0.016)
GDP$_i$	0.716***	0.684***	0.844***
	(0.065)	(0.084)	(0.068)
GDP$_j$	0.794***	0.779***	0.856***
	(0.032)	(0.044)	(0.034)
REER	-0.516***	-0.798***	-0.532***
	(0.100)	(0.125)	(0.113)
Fixed effects	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Observations	34302	34302	34302
R^2	0.455	0.251	0.407
Adjusted R^2	0.455	0.251	0.407

Notes: *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively. Robust standard errors between brackets. The dependent variable is the natural logarithm of trade. 1-month ibr stands for one-month interbank rate. GDP for both countries and the real effective exchange rate (REER) are also in logarithms. Hom. and Dif. refer to homogenous and differentiated goods, which are categorized according to the conservative classification by Rauch (1999). All regressions include a constant. Subscript *i* and *j* refer to the exporting and importing country, respectively.