ECONSTOR
Make Your Publications Visible.

A Service of

ZBW Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Niepmann, Friederike; Schmidt-Eisenlohr, Tim

Working Paper

International Trade, Risk and the Role of Banks

CESifo Working Paper, No. 4761

Provided in Cooperation with:
Ifo Institute – Leibniz Institute for Economic Research at the University of Munich

Suggested Citation: Niepmann, Friederike; Schmidt-Eisenlohr, Tim (2014) : International Trade, Risk and the Role of Banks, CESifo Working Paper, No. 4761, Center for Economic Studies and ifo Institute (CESifo), Munich

This Version is available at:
https://hdl.handle.net/10419/96852

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

WWW.ECONSTOR.EU

Mitglied der Leibniz-Gemeinschaft

The international platform of Ludwig-Maximilians University's Center for Economic Studies and the Ifo Institute

CESifo Working Papers

www.cesifo.org/wp

International Trade, Risk and the Role of Banks

Friederike Niepmann
Tim Schmidt-Eisenlohr

CESIFO WORKING PAPER NO. 4761
CATEGORY 8: TRADE POLICY
APRIL 2014

An electronic version of the paper may be downloaded
- *from the SSRN website:* *www.SSRN.com*
- *from the RePEc website:* *www.RePEc.org*
- *from the CESifo website:* *www.CESifo-group.org/wp*

CESifo
Center for Economic Studies & Ifo Institute

CESifo *Working Paper No. 4761*

International Trade, Risk and the Role of Banks

Abstract

Banks play a critical role in facilitating international trade by guaranteeing international payments and thereby reducing the risk of trade transactions. This paper employs banking data from the U.S. to document new empirical patterns regarding the use of letters of credit and similar bank guarantees. The analysis reveals that trade finance is a large and highly concentrated business. It corresponds to roughly 20 percent of U.S. exports, with the top five banks extending more than 90 percent of the guarantees. We find that exporters use letters of credit the most when exporting to countries with intermediate levels of risk. Moreover, they rely more on this instrument in times when funding is cheap and aggregate uncertainty is high. However, firms do not respond uniformly to changes in global interest rates and risk. Those that ship to high and low risk countries adjust their use of letters of credit the most. A modification of the standard model of payment contract choice in international trade is needed to rationalize these empirical findings.

JEL-Code: F210, F230, F340, G210.

Keywords: trade finance, multinational banks, risk, letter of credit.

Friederike Niepmann
Federal Reserve Bank of New York
Research and Statistics Group
33 Liberty Street
USA – New York, NY 10045
Friederike.Niepmann@ny.frb.org

Tim Schmidt-Eisenlohr
Economics Department
University of Illinois at Urbana-Champaign
214 David Kinley Hall
1407 W. Gregory
USA – Urbana, Illinois 61801
T.SchmidtEisenlohr@gmail.com

April 15, 2014
The authors especially thank Sydnee Caldwell and Geoffrey Barnes for excellent research assistance. For their useful comments, they also thank Andrew Bernard, Morten Olsen, Veronica Rappoport, Valerie Smeets and Catherine Thomas, as well as participants in workshops at the New York FED and NYU as well as in the 2014 EITI Conference. The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

1 Introduction

When exporters and importers engage in a trade, they face substantial risks. To mitigate these risks, firms can turn to financial intermediaries who offer letters of credit (LCs) and similar export and import guarantees for a fee.[1] This paper uses previously unexplored data on U.S. banks' trade finance claims to shed light on the use of bank guarantees in international trade. We show, for the first time, the extent to which U.S. exporters employ LCs and how their use varies across destination countries and over time. Our findings have implications for several central aspects of the literature on finance and international trade, in particular for trade costs, the effect of financial shocks on trade and current payment contract choice theory.

Trade costs are seen as one of the main determinants of trade patterns besides differences in technology and factor endowments.[2] It is an open question to which extent trade finance represents a relevant part of these trade costs and what factors determine the cost of trade finance. Our analysis allows us to shed some light on these matters. In particular, we show that the use of LCs is common among U.S. exporters and that it varies systematically with aggregate risk and funding conditions. We furthermore provide strong indirect evidence that the cost of trade finance increases with shipping times. Finally, we uncover that bank guarantees are used the most in destination countries with intermediate levels of risk. These findings suggest that trade costs associated with trade finance, which represent variable trade costs, are not stable over time but may fluctuate in the short run. They further imply that trade finance costs vary systematically with country characteristics like risk, distance to the U.S. and the efficiency of import processing.

A growing literature in international economics analyzes the effects of financial shocks on trade.[3] Most of these studies take a reduced form approach and focus on the effect of a reduction in the availability of credit on exports. The analysis in this paper suggests that bank guarantees may represent an additional channel through which financial shocks can affect trade. When firms cannot get a guarantee from a bank, they may not trade altogether. Our findings that the use of LCs is heterogeneous across countries and depends on country risk suggest that shocks to the availability of LCs and trade finance, in general, should affect trade differentially across countries.[4]

[1] In a letter of credit, a bank acts as an intermediary. The bank ensures that the importer commits to paying before the exporter produces and only pays the exporter if he documents that he produced and shipped the goods. In this way, the risk that the importer or the exporter defaults on his obligation to deliver or to pay is mitigated.

[2] Traditionally, more emphasis has been put on geography as a determinant of trade costs, see, for example, Eaton and Kortum (2002). However, more recent works study other factors that affect trade costs, such as institutions, networks and financing costs. See among others Levchenko (2007), Nunn (2007), Rauch (1999), Chor and Manova (2012), and Schmidt-Eisenlohr (2013). See Anderson and van Wincoop (2004) for a seminal paper on trade costs.

[3] See, in particular, Amiti and Weinstein (2011), Paravisini et al. (2011), and Ahn (2013) and Niepmann and Schmidt-Eisenlohr (2013). Related to this is a set of papers that study the relationship between trade patterns and financial development. See, e.g., Beck (2002), Beck (2003), Manova (2013) and Schmidt-Eisenlohr (2013).

[4] In a companion paper, Niepmann and Schmidt-Eisenlohr (2013) study this risk channel in more detail and find that shocks to the supply of LCs have indeed heterogenous effects across countries.

Our results are particularly relevant for the theory of payment contract choice in international trade, which researchers have developed over the past years.[5] Existing models have been tested only to a limited extent due to a lack of available data. The unique feature of the U.S. data is that they vary both across destination countries and over time, which allows us to evaluate aspects that have not been investigated before. The analysis shows that the standard payment contract choice model can explain the response of trade finance to interest rates and aggregate uncertainty, but it cannot rationalize the relationship between the use of LCs and destination country risk. We present a simple modification to the model that can generate all patterns in the data, thereby improving on existing theory.

While this study focuses on country level variation, we also investigate trade finance at the bank level. We provide extensive bank-level statistics showing that the business is highly concentrated, with the top five banks taking roughly 90 percent of the business, and that on average smaller and more remote destinations are served by larger banks. Understanding the market structure of the business and the supply of and demand for trade finance in more detail is central to policy makers as most development banks run large trade finance programs and confirm LCs in emerging and developing countries.[6]

The dataset used in this paper captures the trade finance activities of all large U.S. banks with foreign counter-parties and primarily reflects confirmed LCs and similar bank guarantees that facilitate U.S. export activity.[7] The aggregate statistics presented in the beginning of this work reveal that trade finance is very relevant for the U.S. In the second quarter of 2012, the total stock of trade finance claims held by U.S. banks amounted to 20 percent of total U.S. exports.

Based on this data, we document the following relationships that have not been shown before. (i) The volume of trade finance relative to exports increases when global risk rises. To proxy for changes in global risk, we use the CBOE Volatility Index (VIX), which measures the expected volatility of the U.S. stock market over the next month and reflects risk attitudes of both U.S. and global investors. (ii) Trade finance decreases when global interest rates rise. This holds when global funding conditions are proxied by the 3-month London Interbank Rate (Libor) or by the Fed Funds Rate.

(iii) Banks' trade finance claims increase with the time to trade. Trading time is captured by two different measures that vary across destination countries: distance and the time to import. Both variables have a positive and significant effect on the volume of bank trade finance, which strongly suggests that financing costs increase with the time to trade. (iv) Trade finance is hump-shaped in country risk, that is, the trade finance claims of U.S. banks are largest in countries with intermediate levels of default risk. (v) The response of trade finance to changes in global conditions (in the VIX and the Libor) is heterogeneous across countries. Trade finance responds the least in countries with intermediate levels of risk,

[5] See Schmidt-Eisenlohr (2013), Glady and Potin (2011), Ahn (2011) and Olsen (2013) for models that predict when LCs are used. Other related theoretical papers are Antràs and Foley (2011), Eck et al. (2012), and Hoefele et al. (2012).

[6] For example, the International Finance Corporation (IFC), an entity of the World Bank Group, has a large program to confirm LCs. See IFC (2012) for details.

[7] We will refer to LCs and similar trade guarantees provided by banks as trade finance throughout the paper.

which rely most on banks to facilitate trade.

Additionally, we show that the same factors that increase trade finance also trigger entry by banks into a destination market and affect concentration. The larger U.S. exports to a country are and the longer the time to trade is, the larger the number of banks that serve the destination market and the less concentrated is the business. Similarly, in countries with intermediate levels of risk, more banks are active that are, on average, smaller. This suggests that fixed costs play an important role for banks in the supply of trade guarantees.

The empirical findings are consistent with a modified version of the trade finance model in Schmidt-Eisenlohr (2013). In the model, firms have the choice between three different payment forms. First, they can agree to trade on open account terms, in which case the exporter produces first and the importer pays after receiving the goods. Second, they can trade on cash-in-advance terms. Then the importer pays first and the exporter produces after receiving the payment. Third, trading partners can use banks to facilitate trade. This can be desirable because banks are able to reduce the risk that the importer or the exporter defaults on her obligation.[8] In this case, the importer obtains a LC from a local bank for a fee, which is confirmed by a bank in the country of the exporter and guarantees that the exporter is paid. The latter payment method is reflected in the bank data analyzed in this paper.

The model predicts that trading partners choose among the three payment methods to optimally trade off differences in financing costs and default probabilities between the two countries. In contrast to Schmidt-Eisenlohr (2013), in which the LC fee is fixed, the fee in this paper consists of a fixed monitoring cost plus a variable cost related to the expected loss of the confirming bank, which increases in the importer's default probability. Without this modification, the hump-shaped relationship between the volume of trade finance claims and credit risk and the heterogeneous responses to global conditions are not predicted by the theory.

Consistent with the observation that trade finance claims expand relative to exports when the VIX rises, the theory shows that the relative profitability of LCs increases when the default risk increases proportionately in both the exporting and the importing country. An increase in global interest rates has the opposite effect. When interest rates increase by the same amount in both countries, LCs experience a larger increase in costs than the two alternatives and are used less (in line with finding (ii)). This is because both the exporter and the importer have to do some pre-financing under this payment form.

The model can also explain the finding that trade finance claims are hump-shaped in destination country risk, i.e. that trade finance is used the most in countries with intermediate risk. In the modified model, the higher the risk is that the importer defaults, the higher is the cost of a LC. When trading partners trade on cash-in-advance terms, the risk on the importer's side is eliminated because the exporter only produces after receiving the payment. With high levels of payment risk in the destination country, cash-in-advance is therefore the preferred financing form. In contrast, if the risk in the importing country is low,

[8]See the more detailed discussion of LCs in the next section and the model for details on how banks are able to reduce the risk of non-payment. Olsen (2013) provides a micro-foundation for the proposed mechanism.

open account is optimal because it is not worthwhile for the trading partners to incur the LC fee. LCs are thus most preferred at intermediate levels of destination country payment risk.

Finally, we show that the model can also generate the observed heterogeneous response to changes in global conditions. When almost all firms in countries with intermediate levels of risk trade based on bank guarantees, while low and high risk countries use also one of the other payment methods, changes in interest rates and risk lead to substantial payment contract switching in low and high risk countries. Countries with intermediate risk show hardly any response and the observed use of LCs is less elastic in those countries.

Literature While the evidence on trade finance has increased in recent years, it is still very limited and is mostly based on voluntary surveys of banks, which provide only an incomplete picture.[9] In this paper, we analyze data which banks are required to provide to U.S. regulators and which has not been studied before.

There are only few works that analyze information on the use of LCs and bank trade finance in general. Glady and Potin (2011) provide a model of payment contract choice and use SWIFT transactions data for the year 2006 to test it. This data contains details on the number of LC transactions between different countries but not on the values of these transactions. The authors find that the use of LCs increases in country risk. Their empirical results also suggest a hump-shaped relationship, a finding which is, however, not predicted by their theory and not discussed by the authors.

In recent empirical work, Del Prete and Federico (2012) study the effect of financial shocks on trade based on detailed information on bank trade finance in Italy. They observe bank loans and guarantees separately for exports and imports, but, in contrast to this paper, do not have information on the partner countries. Thus our work, unlike previous research, exploits information on the value of trade finance by destination country. In addition, it spans a much larger time period– 1997 until 2012– which allows us to study the behavior of trade finance over the business cycle.

Without elaborating on differences across countries, Ahn (2013) investigates whether financial shocks in 2008/2009 affected the use of LCs based on matched bank-importer-exporter data from Columbia. Both Antràs and Foley (2011) and Hoefele et al. (2012) use firm-level data to study how the choice between cash-in-advance and open account is affected by country characteristics. However, they have no or only very limited information on LC transactions.

Entry into markets and the concentration of the trade finance business by destination country, analyzed in section 3.2 of this paper, have not been studied before. The analysis of entry links to work in Niepmann (2013) on the international activities of banks. As in the aforementioned study, we find evidence that fixed costs are highly relevant for banks when

[9]See, in particular, surveys by the International Monetary Fund (IMF) and the International Chamber of Commerce (ICC) in ICC (2009) and IMF (2009). Results of the first four IMF surveys have been summarized by Asmundson et al. (2011). The ICC has started collecting more comprehensive data in its so-called Trade Register, which is, however, not available to researchers. See ICC (2013).

entering foreign markets.

The role of time to trade was first studied empirically in Hummels and Schaur (2013). Schmidt-Eisenlohr (2013), Bourgeon et al. (2012), and Paravisini et al. (2011) investigate how trading time affects the response of trade to changes in financial conditions.[10] This paper provides more direct evidence that financing costs indeed increase with the time to trade.

By modifying Schmidt-Eisenlohr (2013) to match the data, this paper also contributes to the theoretical literature on trade finance. Several other papers have studied the choice between payment forms. Antràs and Foley (2011) extend the model in Schmidt-Eisenlohr (2013) to a dynamic setting. Glady and Potin (2011) introduce heterogeneous firms and asymmetric information to the framework. Hoefele et al. (2012) derive new predictions on the role of industry complexity. Ahn (2011) studies the effect of changes in aggregate default risk on the ratio of exports over domestic sales. In his model, LCs reduce the commitment problem of the importer to a lesser extent than in this paper. This leads to the opposite prediction that, in a crisis, as both importer risk and bank risk rise, LCs become relatively less attractive. None of the aforementioned papers derive predictions that match the empirical patterns documented here.

The paper is structured as follows. Section 2 provides details on data sources and aggregate statistics. Section 3 presents the empirical results. Section 4 discusses the theoretical model and shows that it is consistent with the observed patterns in the data. Section 5 concludes.

2 Background on Letters of Credit and the Data

2.1 Data source

Data on the trade finance claims of U.S. banks is from the Country Exposure Report (FFIEC 009). U.S. banks that have more than $30 million in total foreign assets are required to file this report and, among others, have to provide information on their trade finance related claims. Specifically, banks have to report claims with maturity up to one year against parties residing in foreign countries that are "directly related to exports and imports and will be liquidated through the proceeds of international trade". Trade finance related loans to firms with residency in the U.S. and bank guarantees that cover U.S. obligations are not reported. The observed measure of trade finance thus represents only a fraction of the overall trade finance activities of the U.S. banking sector but it captures the activities of all large banks with foreign parties. Claims are reported on a consolidated basis, that is, they also include the loans and guarantees extended by the foreign affiliates of U.S. banks. While several different instruments are potentially included in the reported numbers, the data mainly reflects confirmed LCs and similar bank guarantees that are used to finance trade transactions between U.S. exporters and foreign importers. This is confirmed by external

[10] Also related is Berman et al. (2012) who study how distance influences the adverse effects of financial crisis on trade.

information on LCs from the SWIFT Institute. A detailed discussion of the data and the reporting instructions are given in the appendix of the online version.

2.2 How a letter of credit works

A LC is an instrument to increase the reliability of payment in a trade transaction. It works as follows: An importer asks her bank to issue a LC on her behalf. This letter is then sent to the exporter. It guarantees that the issuing bank pays the agreed contract value to the exporter if a set of conditions is fulfilled. These conditions typically include delivering a collection of documents to the bank, e.g., shipping documents that confirm the arrival of the goods in the destination country. However, there is still a risk that the guaranteeing bank defaults on its obligation. To address this concern, a bank in the country of the exporter typically confirms the LC. The confirming bank thereby agrees to pay the exporter if the issuing bank defaults. Figure 1 summarizes how a LC works.

The trade finance data can include LCs that are issued to a foreign importer by a foreign affiliate of a U.S. bank and those that are issued by a local bank and then confirmed by a U.S. bank. There is a correspondence between the value of U.S. exports and banks' trade finance claims. If a U.S. bank confirms a LC or if its foreign affiliate issues a LC, for example, to a Spanish importer, then the U.S. banking group has claims on a Spanish party that are equivalent to the value of the goods that are exported from the U.S. to Spain. These claims are reported in the Country Exposure Report as trade finance claims against Spain.

Banks' trade finance claims by destination country are available at a quarterly frequency starting from 1997.[11] Quarterly trade data is from the IMF's Directions of Trade Statistics. Additional data sources are reported in the data appendix.

2.3 The trade finance business of U.S. banks

Bank trade finance in the aggregate The dataset used in this paper captures a substantial amount of trade finance in the U.S. Over the period from 1997 until the middle of 2012, the trade finance claims of all reporting U.S. banks represent on average 14 percent of U.S. quarterly exports in goods. Quarterly exports are a good basis for comparison because trade finance is typically short term. Using data from international banks participating in the Trade Register, the International Chamber of Commerce (ICC (2013)) calculates that the average maturity of a confirmed LC is 70 days, while the average maturity of an importer LC is estimated to be 80 days.

[11] Until 2005, trade finance claims are reported on an immediate borrower basis, that is, a claim is attributed to the country were the contracting counter-party resides. From 2006 onwards, claims are given based on the location of the ultimate guarantor of the claim (ultimate risk basis). See http://www.ffiec.gov/ for more details. This reporting change does not appear to affect the value of banks' trade finance claims in a systematic way. Consequently, we use the entire time series without explicitly accounting for the change. Statisticians at the Federal Reserve of New York, who are familiar with the reporting instructions, confirm that risk transfers, which make values on the immediate borrower basis diverge from those on an ultimate risk basis, are less relevant for trade finance products.

In the last 15 years, there have been substantial changes in the trade finance business of U.S. banks. As the solid line in Figure 2 shows, total trade finance claims were relatively flat until 2006 at about $20-30 billion.[12] Since then trade finance has risen sharply to reach more than $70 billion by 2012. Figure 2 also indicates how the ratio of trade finance over exports, depicted by the dotted line, evolved between 1997 and 2012. We call this measure the trade finance intensity, which captures the share of exports that are settled based on LCs. Over the observed period, it roughly followed a u-shape reaching 20 percent in 2012.

Three additional features of the data series stand out. First, there was a peak in 1998 both in terms of volumes and trade finance intensity, at the time of the Asian crisis. Second, in the recent 2008-2009 financial crisis bank trade finance first increased and then declined steeply. Figure 3 zooms into the crisis period displaying growth rates for trade finance claims and exports separately. There is a striking divergence between trade finance growth and export growth in the fourth quarter of 2007. In this period, trade finance claims jumped by 42 percent while exports only increased by 7.2 percent. Starting from the third quarter in 2008, both trade finance and export growth rates were negative for three consecutive periods. The biggest drop in trade finance and exports occurred in the second quarter of 2009 with both indicators falling by roughly 18 percent. The observed pattern is in line with the following interpretation. The initial increase in 2007 was driven by a higher demand for trade finance due to the riskier global environment. However, when the major crisis hit in 2008, two effects came into play. Trade volumes declined, reducing the demand for trade finance. In addition, the supply of trade finance was lower because banks faced liquidity problems and contracted lending and guarantees. These two effects dominated the demand generated by the increased risk and led to a decline in overall trade finance claims. The pattern of trade finance during the crisis is consistent with evidence from Italy in Del Prete and Federico (2012) and from Korea in Rhee and Song (2013), who also find that bank trade finance first increased and then decreased.

The final observation concerns the period after 2009. Since 2010, trade finance claims have risen sharply. One factor that explains the recent growth is that firms have substituted away from European banks to U.S. banks. In the aftermath of the recent crisis, several European banks exited the trade finance business, especially in Asia, and banks from other countries took over.[13] The low interest rate environment over the past years may also have contributed to the rise. As we will show, trade finance generally expands when funding conditions ease.

Geographical distribution The trade finance activities of U.S. banks vary widely across countries. The upper panel of figure 4 shows the top countries in terms of average absolute values of trade finance claims from 2006 q1 to 2012 q2. Not surprisingly, several countries that exhibit the highest trade finance claims are also top trading partners (see the middle panel) over the same period. China and Mexico, for example, are in the top 5 in terms of

[12]The aggregate numbers exclude observations for one bank that changed its trade finance business fundamentally in the reporting period.

[13]Decomposing the increase shows that a larger part of the growth was indeed due to activities in Asia. See http://wongchienmi.files.wordpress.com/2012/02/trade-finance-focus-cmw.pdf for a business report on trade finance in Asia from May 2012.

both measures.

The lower graph of figure 4 displays the 25 countries with the highest ratio of trade finance claims to U.S. exports. This set of countries differs considerably from the one in the top graph. Three factors apparently impact the trade finance intensity of a country: distance to the U.S., offshore center status and country risk. While we conduct a detailed econometric analysis of the different factors, one or more of these characteristics can be easily assigned to each of the countries. All countries in the list but Bermuda and Barbados are far away from the U.S. Offshore centers in the top 25 are Bermuda, Mauritius, Malidives, Macao and Barbados, indicated with patterned bars in the graph.[14] Only five of the 25 countries listed have average risk ratings over the period that lie below the 25 percentile (Korea and Kuwait) or above the 75 percentile (Pakistan, Malawi and Uzbekistan) of the country risk distribution. As we show in more detail later, trade with intermediate risk countries relies the most on trade finance.

Note that offshore centers are excluded from the analysis in section 3 because the data shows that these countries attract large amounts of bank trade finance even in the absence of corresponding trade flows.[15]

Bank-level statistics Trade finance is a more concentrated business in comparison with the overall banking industry. In the first quarter of 1997, the top 5 banks had a joint share of 66 percent in total trade finance claims. Nine years later, this share had increased to 92 percent, remaining stable until 2012.[16] For comparison, the share of the top 5 banks in total bank assets was 39 percent in 1997 q1, 73 percent in 2006 q1 and 80 percent in 2012 q1 based on the sample of banks that reported positive trade finance activities in at least one quarter over the sample period.[17] Del Prete and Federico (2012) report similar levels of concentration for Italy in the market for bank guarantees and find that the export and

[14]The country with the highest trade finance intensity is Bermuda with an average ratio of 3.425. Countries can have trade finance intensities that are larger than 1 if trade transactions take more than three months or if some of the trade finance activities are not related to U.S. exports with that country.

[15]We discuss the behavior of trade finance claims in offshore centers in more detail in the appendix of the online version. The share of trade finance claims in offshore centers in banks' total claims amounted to 5 percent of total claims in 2012, down from around 9 percent in 2006. For comparison, the share of offshore exports in total U.S. exports was 3.4 percent in 2006 and 3.8 percent in 2012. For a list of countries designated as offshore centers, see the data appendix.

[16]Real concentration could be lower because we do not observe the trade finance claims of banks that fall below the reporting threshold. However, our data suggests that this is unlikely to be the case. In the first quarter of 2012, we observe 19 banks with positive trade finance claims while 41 banks had zero trade finance positions. More importantly, we see that the likelihood of positive trade finance claims increases with a banks' total assets. This strongly suggests that banks below the threshold barely provide the type of trade finance guarantees reported in the data. We can, however, calculate a back-of-the-envelope lower bound on concentration. Assume that all other commercial banks in the U.S. (additional 6158 banks in 2012 q1) had $30 million of foreign assets (the reporting threshold) and suppose that 9.4 percent of these assets were trade finance claims in 2012 q1 (the mean exposure of banks in the data). Total trade finance claims would then be around $90 billion and the share of the top 5 banks would fall to 72 percent.

[17]The actual degree of concentration of the U.S. banking industry is lower. In these calculations, only banks that hold positive trade finance claims are included. Thus practically all small and medium-sized banks are excluded.

import loan business, which we do not observe in the U.S. data, is much less concentrated.

Our data also allows us to analyze the country coverage over time. Altogether banks had positive trade finance claims in 120 countries in the first quarter of 2006 compared to 138 in the same quarter in 2012. Similarly, the average number of countries per bank increased over this period. Banks held claims in an average of 26 destination countries in 2012, up from 22 countries in 2006.[18]

3 Empirical Patterns

The statistics presented in the previous section have already alluded to important features of the data. In this section, we use regression analysis to further explore how trade finance varies over time and across countries. We document the following highly robust patterns that have not been shown before. (i) Banks' trade finance claims increase in aggregate risk and decrease in global financing costs. (ii) Trade finance increases in the time to trade and (iii) is hump-shaped in the default risk of a destination country. (iv) The response of trade finance claims to changes in aggregate risk and interest rates depends on the risk of a destination country. Countries with intermediate levels of risk adjust the least.

3.1 The effect of aggregate factors

We start by studying the relationship between trade finance, aggregate risk and global funding conditions. The analysis shows that the use of trade finance varies systematically with these macroeconomic factors. While this finding is interesting in itself, and we will show that it can be rationalized with a model of payment contract choice, it is also relevant for our understanding of trade costs. Variable trade costs are typically thought of as being determined by geography and transportation costs, factors that are constant or only slowly change over time. In a recent paper, Schmidt-Eisenlohr (2013) shows that the costs associated with trade finance also constitute variable trade costs.[19] The fact that the use of LCs varies over the business cycle therefore indicates that variable trade costs are not stable over time, but fluctuate with macroeconomic conditions, a point that to our knowledge has not been raised in the literature.

Trade finance increases in global risk First, we study how changes in global risk affect trade finance. The CBOE Volatility Index, called VIX, measures the expected volatility of the U.S. stock market over the next 30 days. Although the index is based on developments

[18] As for total claims, the distribution of destination countries across banks is highly skewed. In 2012, 50 percent of banks were active in less than 10 countries. Only around 20 percent of banks had trade finance with more than 35 countries. More bank-level statistics are reported in the appendix of the online version.

[19] Trade finance costs are mostly proportional to the value of the goods traded. LC fees are typically charged as a percentage of the transaction value, where the percentage price is adjusted for the riskiness and the duration of the guarantee. Some fixed processing fees apply as well, but they seem quantitatively less important. For a detailed theoretical exposition why trade finance represents a variable trade cost see Schmidt-Eisenlohr (2013).

in the U.S., it reflects conditions in global capital markets. It moves up when the price of portfolio insurance increases, i.e. if aggregate uncertainty rises and investors become more fearful. Figure 5 plots trade finance intensity and the VIX over time. There is a clear positive relationship between the two variables. While the VIX measures primarily uncertainty, it also moves with global default risk.[20] Therefore, in times when global default risk, uncertainty and risk aversion are higher, a larger share of trade is backed by bank guarantees.

Changes in aggregate risk potentially affect both the demand for and the supply of trade finance. In times of higher default risk or higher uncertainty, firms may find it more desirable to reduce the risk of trade transactions and, hence, use LCs more often. At the same time, banks probably change their supply and pricing of LCs. In particular, banks may demand a higher fee for the same level of risk when times get riskier as their cost of capital is higher. This generates a countervailing force which limits the expansion of trade finance in riskier times.[21] Since we find that the overall effect of aggregate risk on trade finance is positive, we conclude that the demand effect dominates the supply effect.

Trade finance decreases in interest rates In a next step, we explore the role of aggregate funding conditions for trade finance. Figure 6 shows the evolution of trade finance intensity over time together with the 3-month Libor, the rate at which banks borrow and lend to each other on the London interbank market. The Libor is highly positively correlated with country-specific interbank lending rates and, hence, reflects global funding conditions. The chart indicates that trade finance intensity and the Libor are strongly negatively correlated. When global interest rates are higher, trade finance is lower.

Table 1 confirms what figures 5 and 6 conveyed. It shows the results from OLS regressions where the log of trade finance claims, aggregated over all banks and countries, is regressed on the VIX and the Libor, respectively, as well as additional controls (the log of aggregate U.S. imports, exports, and U.S. GDP). As an alternative to the Libor, we use the Fed funds rate in column (4).[22] Columns (1) to (3) exhibit highly significant coefficients of the Libor and the Volatility Index. In column (4), the coefficient of the Fed funds rate is significant. However, the VIX coefficient is not significant at standard significance levels. This is likely due to multicollinearity between the VIX and the Fed funds rate, which makes it difficult to estimate the effects of the two variables separately, especially given the small sample size. The effects of funding conditions and global risk on trade finance are confirmed by country-level regressions in section 3.3. There, we also run regressions without including the period of the recent financial crisis, which does not change the results. Trade finance claims are higher if funding is cheaper and if global risk is higher.

[20] The VIX is highly correlated with average country risk measured by the Economist Intelligence Unit's country risk index. The correlation coefficient between the log of the VIX and average credit risk is 30 percent. The VIX is our preferred measure of global risk because it is available at a longer horizon than the EIU risk measure which starts in 2000 only. For a description of the EIU risk measure, see the next section.

[21] According to IMF surveys summarized in Asmundson et al. (2011), banks, in fact, increased prices for LCs over the period from 2007 until 2009.

[22] The sample period is 1998 to 2011. The year 1997 is excluded because of one bank whose business strategy has a significant impact in the aggregate. In all other regressions, we also include the year 1997 because time-fixed effects largely take care of this issue.

The effect of changes in interest rates and uncertainty are economically meaningful. An increase in the VIX of one standard deviation from the mean increases trade finance claims by 5.1 percent. Equivalently, an increase in the Libor of one standard deviation from the mean decreases trade finance claims by 10.8 percent.

3.2 Country-level determinants: time to trade and risk

In a next step, we exploit the country dimension of our data to show that banks' trade finance claims vary systematically with the time it takes to ship goods to a destination as well as with the risk of a destination country.

3.2.1 Trade finance is larger the longer the time to trade

There is the notion in the literature that the financing costs of an export transaction increase with the time to trade. Amiti and Weinstein (2011) and Schmidt-Eisenlohr (2013), for example, argue that this is the case because working capital requirements are proportional to the time it takes to get goods from the producer in the source country to the final consumer in the destination country. While some studies have provided indirect evidence for this idea, the effect of time to trade on financing costs has not been directly tested due to a lack of suitable data.[23]

Our data on trade finance by destination country allow us to improve on previous work by testing a closely related relationship between bank guarantees and the time to trade. A guarantee is typically granted for the transaction period, that is, the guarantee usually lapses when the exporter receives her payment from the bank or from the importer. It follows that the longer a transaction takes, the longer the guarantee is granted and thus the longer it remains on the bank's book. As banks have to hold capital against guarantees they extend, the cost of a bank to provide a guarantee increases with the time to trade. Consequently, bank fees and hence firms' trade finance costs, should increase with the time of the underlying export transaction.[24]

To test for the relationship between trade finance and time to trade, we regress the log of trade finance claims in country c at time t on the log of exports as well as on two proxies for the time to trade: distance from the U.S. and a measure of the time goods need to enter the destination country from the Doing Business Indicators of the World Bank.[25] The latter proxy is available for the years starting from 2006 at an annual frequency. Regressions are therefore run on annual data, summed over four quarters. All regressions include time-fixed

[23]For indirect evidence on the relationship see, e.g., Schmidt-Eisenlohr (2013), who introduces an interaction between distance and a country's average net interest rate margin into a standard gravity equation. He finds that the longer the distance between trading partners is, the larger is the negative impact of financing costs on trade. This result has been confirmed with French firm level data by Bourgeon et al. (2012).

[24]It is important to understand that bank guarantees represent an additional channel through which time can affect the relationship between finance and trade above and beyond working capital requirements. With or without a guarantee, firms always need to pre-finance the working capital for international trade. On top of a loan to finance working capital, firms may use a LC or a similar guarantee to settle the trade transaction.

[25]Time to import was first used in Djankov et al. (2010).

effects and control for GDP per capita. Standard errors are clustered at the destination country.

Table 2 presents the results. Consider columns (1) and (2). The coefficients on exports are highly significant and close to one. This shows that banks' trade finance claims strongly covary with U.S. exports. As expected, the estimated coefficients on the two proxies for trading time are all positive and highly significant. Controlling for the volume of trade and GDP per capita, banks' trade finance claims are larger, the further away the destination country and the longer the time needed to import goods.[26]

IV approach The regressions reported in columns (1) and (2) of table 2 may suffer from endogeneity bias. As trade finance and exports are likely to be determined by unobserved common factors and there is a two-way relationship, the estimated coefficients may be biased. In order to address this issue, we instrument the log of exports by the log of population. The size of the population is an excellent instrument because it is highly correlated with exports. At the same time, population should affect the supply of trade finance only through its effect on exports.

The IV regressions are shown in columns (3) to (6) of table 2. Columns (3) and (5) present the results of first stage regressions where the endogenous variable, the log of exports, is regressed on the instrument, the log of population, and all other exogenous variables. In both regressions, the population coefficient is positive and significant at a 1 percent significance level. All proxies for trading time have a negative effect on exports as one would expect.

The second stage results are shown in columns (4) and (6). Compared to columns (1) and (2), the results are qualitatively the same. The magnitudes of all coefficients increase slightly compared to the OLS specification, which suggests that the estimates are biased downward when endogeneity is not accounted for.

The estimates are very similar when regressions are run on bank-level data and time- and bank-fixed effects are included.[27] Additional robustness checks are discussed in the appendix of the online version. Altogether, we find strong evidence that time to trade increases the volume of banks' trade finance claims and therefore increases the cost of trade finance. The findings also imply that, from the point of view of banks, the demand for trade finance is higher the longer it takes to transport goods to a destination market. An export transaction of the same value requires a longer guarantee when goods are exported to a remote destination compared to a closely located country so that banks' profit opportunities are higher when transaction times are longer.

[26] We also test for the effect of the mode of transport on trade finance. The data suggests that trade finance claims increase in the share of goods transported by vessel (as compared to air). However, the result is not robust to the inclusion of GDP per capita as a control variable. This may be due to a multi-collinearity problem because the transport mode is highly correlated with a country's per capita income.

[27] These results are available upon request.

3.2.2 Trade finance is hump-shaped in destination country risk

The trade finance literature has also emphasized the role of risk. One of the main concerns for a firm in international trade is that its counter-party may default on the contract. This can happen because the trading partner cannot or does not want to fulfill his or her obligation to deliver or to pay. Intuitively, we expect default risk to be correlated across firms within a country, which share the same legal system, financial sector and social norms and are exposed to the same aggregate shocks. To the extent that default risk varies across countries, the use of trade finance, which is a means to reduce risk, should differ as well. In the following, we provide evidence for a systematic relationship between country risk and trade finance. Later on, in the theory section of this paper, we rationalize these findings.

In order to proxy destination country risk, we use the country risk index provided by the Economist Intelligence Unit (EIU), which is a composite index of sovereign, currency and banking risk and is available for the period from 2000 to 2011. The higher the index, the higher a country's default risk. To test for the effect of risk on trade finance, the following equation is estimated:

$$\begin{aligned} \log(tf_{ct}) &= \beta_1 \log(\exp_{ct}) + \beta_2 \log(\text{GDPpc}_{ct}) + \beta_3 \log(\text{distance}_c) + \\ &+ \beta_4 \text{ risk}_{ct} + \beta_5 (\text{risk}_{ct})^2 + \alpha_t + (\alpha_c) + \epsilon_{ct} \end{aligned} \tag{1}$$

The log of trade finance claims is regressed on the log of exports, the log of distance as well as risk and risk squared. To account for other factors that might be correlated with risk and affect trade finance, the log of nominal GDP per capita is also included as a control variable.[28] Regressions are again run on annual data, aggregated over all banks and summed over four quarters. OLS regression results are reported in table 3. All columns include time-fixed effects.

Column (1) of table 3 includes the variable risk but excludes risk squared. The coefficient on risk is positive but not significant at a 10 percent significance level. In column (2), risk squared is added as a regressor. Now, both coefficients related to risk and risk squared are significant at a 5 percent significance level. The coefficient on risk squared is negative and the coefficient on risk is positive, which suggests a hump-shaped relationship between trade finance and country risk. In other words, trade finance, controlling for exports, is highest in countries with intermediate levels of default risk. While this might be surprising at a first glance, the theory section shows exactly why we should expect this result. Intuitively, low destination risk transactions are done on open account. As risk rises, firms start using LCs. However, when the destination country gets very risky, LCs become too expensive and firms shift to settling transactions on cash-in-advance terms.

As columns (3) and (4) of table 3 show, the hump shape is robust to controlling for the log of GDP per capita squared as well as the time to import. Including country-fixed effects in addition to time-fixed effects affects the results by lowering the size of the coefficients and increasing standard errors (see columns (5) and (6)). However, when we correct for

[28] Results become stronger if GDP per capita is left out as this variable is highly correlated with country risk.

endogeneity via IV in table 4, the significance levels increase substantially and the magnitudes of the coefficients on risk and risk squared are very similar with and without country-fixed effects.

Figure 7 shows the predicted level of the log of trade finance as a function of country risk. According to the estimates in column (5) of table 3, the peak of the hump is reached at a value of around 57.75, which corresponds to the risk levels of Argentina in 2010 and of Honduras in 2008, for example. If time-fixed effects are left out (see column (2) of table 3), the peak of the hump is at a lower risk level of 45.3. The mean and median value of risk in the sample is 47.

The hump-shaped relationship between trade finance claims and country risk is economically relevant. Based on the estimates in column (5), if Brazil (risk index of 41.5 in 2010) became as risky as Argentina (risk index of 57.75 in 2010), U.S. banks' trade finance claims would increase by approximately 18.5 percent. If Argentina had the same credit risk as Venezuela (risk index of 70 in 2010), trade finance claims in Argentina would decline by around 10 percent. We show in section 3.3 that the curvature of the hump depends on aggregate risk and interest rate conditions. Differences in trade finance claims between countries with different risk levels are even more pronounced when global risk is low and interest rates are high.

Results do not change when regressions are run at the bank-level and include bank-, time- and country-fixed effects. A similar pattern also emerges when we employ semi-parametric estimation techniques. The appendix of the online version discusses robustness checks in more detail. All the presented results strongly suggest that trade finance is hump-shaped in destination country risk.

3.2.3 The same factors that determine trade finance in the aggregate trigger bank entry

So far, we have documented that banks' trade finance claims increase with the value of goods exported and with the time to ship to a destination market and that claims are largest in countries with intermediate levels of risk. We argue that these factors determine the country-level demand for trade finance and hence the profit opportunities for banks related to a given export market. To provide further evidence for this, we investigate whether exports, time to trade and country risk trigger entry by banks into markets and systematically affect concentration at the country-level. Entry and market concentration are relevant per se because they affect the ability of firms to find a trade finance supplier and the ease at which they can switch between different banks. Moreover, concentration may affect firms' cost of trade finance as it should affect the market power of banks.

Our findings on bank entry are consistent with a model of banking where banks are heterogenous and pay a fixed entry cost per market.[29] Factors that imply a larger trade finance market size lead to more entry and less concentration. We show this for three measures of entry and concentration that address different moments of the within-country

[29]See Niepmann (2013) for a model with heterogeneous banks and fixed entry costs.

bank distribution: the number of banks active, the size of the smallest bank active, and the share of the largest three trade finance providers in total trade finance in a given country. The additional results strongly suggest that the demand for trade finance increases in exports and the time to trade and is hump-shaped in country risk. For details see the appendix of the online version.

3.3 Heterogeneous responses to global conditions

In the previous sections, we have established two sets of findings. First, trade finance varies systematically with global conditions. Second, the use of bank guarantees depends on country characteristics. In this section, we combine these two aspects, exploring whether changes in global funding conditions and the risk environment impact destination countries in an asymmetric way. We find that this is indeed the case. Specifically, trade finance responds to macroeconomic factors the most in countries with low and high levels of risk and barely in countries with intermediate levels of risk.

This has implications for variable trade costs and trade patterns. The fact that the use of LCs responds differentially to macroeconomic factors in different countries implies that changes in global risk and interest rates do not affect variable trade costs symmetrically across countries so that the distribution of variable trade costs is modified. This could have first order effects on the patterns of international trade in the short run.

In order to test for heterogeneous responses of trade finance across countries to changes in global conditions, different versions of the following equation are estimated:

$$\begin{aligned} \log(tf_{ct}) &= \beta_1 \log(\exp_{ct}) + \beta_2 \ \text{risk}_{ct} + \beta_3 (\text{risk}_{ct})^2 \\ &+ \beta_4 \ (\text{risk}_{ct} \times \log(\text{global factor}_t)) + \beta_5 ((\text{risk}_{ct})^2 \times \log(\text{global factor}_t)) \\ &+ \alpha_t + \alpha_c + \epsilon_{ct}, \end{aligned} \tag{2}$$

where the variable *global factor* corresponds either to the VIX or the Libor. We run regressions on quarterly data and cluster standard errors at the destination country.

3.3.1 The response to changes in the VIX is u-shaped in country risk

To check whether an increase in global risk increases trade finance equally across countries, we estimate the effect of interactions between the log of the VIX and the EIU risk measure. Table 5 presents the results. All columns include country-fixed effects.

Start by considering column (1) of table 5, which displays the results of an OLS regression that includes a simple interaction term between the VIX and country risk. The interaction term is negative and the estimated coefficient on the VIX is positive. In column (2), an interaction term between the VIX and risk squared is added to the regression. Now all coefficients on risk, the VIX and the interaction terms are highly significant. Results are unchanged when time-fixed effects are included in the regression (column 3) and exports are instrumented by domestic absorption, calculated as GDP minus exports plus imports. Column (4) shows the first stage and column (5) the second stage results of the IV regression.

Domestic absorption replaces population as the instrument as the latter is not available at a quarterly frequency. To analyze the effect of the VIX, it is necessary to run regressions at this higher frequency because aggregation over the year would remove much of the relevant information from the data.[30]

Figure 8 plots the estimated response of trade finance claims to a change in the VIX for different country risk levels based on the coefficients in column (2) of table 5. The estimated response to a change in global risk is close to zero for countries with intermediate levels of risk and strongly positive for countries with low and high levels of default risk. According to the estimates, if the VIX increases by 10 percent, the trade finance claims of U.S. banks in Chile, which has a risk index of 28 in 2012, increase by around 4.5 percent. In contrast, trade finance claims in China, whose risk index takes a value of 42 in 2012, are not predicted to increase.

3.3.2 The response to changes in the Libor is hump-shaped in country risk

In a next step, we test whether countries with different risk levels also respond differentially to changes in global funding conditions. Results are presented in table 6. As before, country-fixed effect are included in all columns.

The regression in column (1) of table 6 only includes an interaction between the Libor and country risk. The coefficient of the Libor is negative and significant and the coefficient of the interaction term is positive and significant. The results in column (2), which includes also an interaction between the Libor and risk squared, indicate that, similar to the response to the VIX, the response is non-linear in country risk. The findings are robust to the inclusion of time-fixed effects (column 3) and to instrumenting exports by domestic absorption (column 5).[31]

Figure 9 shows the estimated effect of a change in the Libor for countries with different risk levels using the coefficients in column (2) of table 6. Again, there is almost no response of trade finance in countries with intermediate levels of risk. In high and low risk countries, however, an increase in the Libor reduces trade finance considerably. According to the chart, if the Libor increases by 10 percent, the trade finance claims of U.S. banks in Chile would decrease by roughly 2 percent. In contrast, the trade finance claims in China would not be affected.

The results in tables 5 and 6 can also be understood in the context of our finding that trade finance is hump-shaped in destination country risk. The estimated coefficients imply that the hump shape becomes stronger or weaker, depending on the prevailing macroeconomic conditions. To see this, consider figure 10. It plots the predicted trade finance claims against country risk based on the estimates in column (2) of table 5 for high global uncertainty (VIX, 75 percentile) and low global uncertainty (VIX, 25 percentile). When the VIX is low, there is a clear hump shape. Countries with intermediate risk use bank guarantees to a much larger

[30]The log of GDP per capita is dropped from the regressions because within-country time variation in GDP per capita is almost perfectly explained by domestic absorption.

[31]The results in tables 5 and 6 are robust to excluding the crisis period from mid-2007 until mid-2009 from the sample.

extent than low and high risk countries. When times get more uncertain (higher VIX), differences in trade finance use between countries are less pronounced. The inverted u-shape is much flatter because high and low risk countries use bank guarantees more extensively than in low risk times.

Figure 11 shows a similar result for different levels of the Libor. When interest rates are high (75 percentile Libor), only countries with intermediate risk use trade finance intensively and there is a clear hump shape. When interest rates are lower (25 percentil Libor), bank guarantees become more attractive and low risk countries and to some extent high risk countries use them more. As a consequence, the hump shape flattens out. We discuss in section 4 how these results match the predictions of our modified payment contract choice model.

3.4 Additional robustness checks

We run a large set of robustness tests, some of which are discussed in detail in the appendix of the online version. All results are robust to the inclusion of the log of imports and a measure of financial development as control variables. Results also hold when we use an alternative risk measure from the Alliant insurance company, which covers a larger number of countries but a shorter time period. We also run regressions, in which we control for arms' length trade and intra-firm trade separately and find very similar coefficients compared to our baseline results. We mention one key robustness check here. We replace trade finance claims by trade finance intensity as the dependent variable, calculating trade finance intensity as the ratio of trade finance claims over exports. Consequently, exports are dropped from the right hand side of the equation. Results are reported in table 7. In column (1), trade finance intensity is regressed on time to trade. Columns (2) and (3) test for the hump shape in risk, columns (4) to (7) for the heterogeneous responses of trade finance to changes in global conditions. All key coefficients are highly significant and have the same signs and magnitudes as before. The patterns that we document are highly robust features of the data.

A caveat of the empirical analysis is that we do not observe trade finance at a more disaggregated level. Payment contract choice is not only affected by country characteristics. Industries and products may differ in the extent to which they use LCs. Hoefele et al. (2012) show that product complexity, for example, systematically affects firms' choice of payment contract. Moreover, trading partners with long-lasting relationships probably rely less on LCs (see, e.g., Antràs and Foley (2011)). Therefore, compositional effects could play a role. These problems are mitigated by the fact that we focus on U.S. exports as opposed to U.S. imports, for which the problem would be more severe.

4 Explaining the Patterns

The previous section documented several new relationships in the data. The use of banks to facilitate trade transactions expands when global risk increases and funding conditions ease. U.S. exporters rely the most on bank guarantees when exporting to destinations with

intermediate levels of default risk. At the same time, bank trade finance in these countries is much less elastic to macroeconomic conditions. In this section, we study the extent to which existing payment contract choice theory can generate these empirical findings and then suggest a simple modification to match all facts.

Models of payment contract choice in line with Schmidt-Eisenlohr (2013), Antràs and Foley (2011), Glady and Potin (2011), and Hoefele et al. (2012) distinguish between three different payment methods: cash-in-advance, open account and LCs. The data used in this paper reflects the latter payment method. It turns out that the benchmark model is successful in explaining the response of trade finance to changes in global conditions. However, the hump-shaped relationship and the heterogeneity in the response to global risk and interest rates across countries are beyond its scope. We show that when the LC fee of the original model is assumed to increase in the default risk of the destination country, the model predictions are fully consistent with the empirical findings.

This assumption is plausible. While information on the pricing of LCs is not available, we have data on average insurance premia charged by the U.S. Export-Import Bank for export transactions to 29 different countries. Figure 12 shows a destination's insurance premium as a function of the EIU risk measure in the year 2004.[32] There is a strong positive relationship. It is likely that the fee of a LC behaves similarly and therefore also increases in destination country risk.[33]

4.1 Model setup

In the model, exporters and importers have the choice between three payment contracts: cash-in-advance (CIA), open account (OA) and letter of credit (LC). It is assumed that one exporter is matched with one importer and that they play a one-shot game. Both firms are risk-neutral. The exporter has all bargaining power and makes a take-it-or-leave-it offer to the importer specifying the type of contract, the price and the quantity. R denotes the sales value of the goods in the destination country and K the production costs in the source country. $1+r$ and $1+r^*$ reflect the financing costs in the source country and the destination country, respectively.

Firms can be of good and bad type. A good firm always fulfills a contract. A bad firm breaks it whenever this is profitable. The share of good firms in the source country is given by η and in the destination country by η^*. If a firm does not voluntarily fulfill a contract, its trading partner can go to court and can try to enforce it. This is successful with exogenous probabilities λ and λ^* in the source and the destination country, respectively.

[32] The data that underlies the graph was first used in Hale et al. (2013) and was kindly provided by the authors. Regressions that show the strong correlation between insurance premia and destination country risk are available upon request.

[33] Anecdotal evidence suggests that the fee of a LC, in fact, increases in issuing bank risk and country risk as well as in the validity period of the LC. See, for example, http://opentoexport.com/article/a-guide-to-letter-of-credit-charges/.

4.1.1 Cash-in-advance

Cash-in-advance is the case in which the importer first pays for the goods and then the exporter delivers them. Due to the time delay between the pre-payment and the arrival of the goods at the destination, the importer needs to pre-finance the transaction at her local interest rate $1 + r^*$. The exporter, in turn, receives the payment before incurring the production costs. This gives rise to a commitment problem because the exporter can decide to keep the money without producing and delivering the goods. Exporters that are of good type (share η) always fulfill the contract whereas bad exporters (share $1 - \eta$) always try to get away without producing. If an exporter defaults on the contract, the importer brings her to court, which successfully enforces the contract with probability λ.

The exporter, who has all bargaining power, chooses the optimal pre-payment C^{CIA} to maximize her expected profits, taking the enforcement probability λ into account.[34] She also respects the participation constraint of the importer. Expected profits of a good exporter can be derived as:

$$\mathrm{E}\left[\Pi_E^{CIA}\right] = \frac{\eta + (1-\eta)\lambda}{1+r^*}R - K. \tag{3}$$

Because the importer pre-finances the transaction, the profitability of cash-in-advance decreases in the financing costs in the destination country $1+r^*$. The commitment problem is on the exporter side. Therefore, stronger contract enforcement and a larger share of good firms in the source country (higher λ and η) increase the expected profits from cash-in-advance.

4.1.2 Open account

Open account is the case where the exporter first sends the goods and then the importer pays for them. The exporter incurs the production costs and delivers the goods to the importer before receiving the payment. Hence, the exporter has to finance the working capital over this period at her interest rate $1+r$. The commitment problem is now on the importer's side. She receives the goods before paying for them. Good importers (share η^*) pay the agreed price in any case, while bad importers (share $1-\eta^*$) try to get away without paying. In this case, the exporter goes to court, which successfully enforces the contract with probability λ^*.

The exporter maximizes expected profits respecting the participation constraint of the importer.[35] The exporter's expected profits are as follows:

$$\mathrm{E}\left[\Pi_E^{OA}\right] \;=\; \frac{\eta^* + (1-\eta^*)\lambda^*}{1+r}R - K. \tag{4}$$

[34] Two cases need to be distinguished: A pooling and a separating case. Under pooling, a bad exporter imitates the good exporter. Under separating, she chooses a different strategy that reveals her type. Following Schmidt-Eisenlohr (2013), we assume that conditions are such that only the pooling case arises. This is the case if $\frac{R}{K} > \frac{(1+r^*)}{\eta}$. See the appendix of the online version for details and a formal derivation of all results.

[35] As we focus on the case where both types of importers participate in trade, the relevant constraint is the participation constraint of good importers. See the appendix of the online version for the details.

Under open account, pre-financing is done by the exporter. Consequently, higher source country financing costs $1+r$ reduce her expected profits. Since the commitment problem is on the importer's side, better contract enforcement and a higher share of good firms in the destination country (higher λ^* and η^*) both increase the profitability of open account.

4.1.3 Letter of credit with fixed fee

A LC is typically issued by a bank in the destination country. It guarantees the payment of the agreed upon price against documents that confirm the arrival of the goods in the destination. Additionally, a LC can be confirmed by a bank in the source country. The confirming bank guarantees the payment of the bank in the destination country. When the risk that the issuing banks defaults is zero, there is no reason for the exporter to ask for a confirmation of the LC. The original model in Schmidt-Eisenlohr (2013) implicitly assumes this and considers only a simple LC. We first present the original formulation where the LC fee is exogenous. In a next step, we present a modification that allows for the possibility that the issuing bank defaults and derive the fee that the importer has to pay for a confirmed LC.

For its guarantee, an issuing bank demands a fee from the importer. Assume that this fee f^{LC} is proportional to the transaction value of the LC C^{LC}. When a LC is used, the exporter only sends the goods once she has received the letter. Conversely, the goods only arrive at the importer after she has committed to the payment by making her bank issue the letter. Under perfect third party verifiability, it is possible for the bank to only pay out the money to the exporter if she has indeed produced and sent off the goods. In this way, a LC can fully resolve the commitment problem of the exporter and the importer at the same time.

Again, the exporter maximizes expected profits, respecting the participation constraint of the importer. This delivers the following profits:

$$\Pi_E^{LC} = \frac{1}{(1+f^{LC}(1+r^*))(1+r)}R - K. \tag{5}$$

As discussed, a LC fully resolves the commitment problems on both sides of the transaction. Thus, enforcement probabilities λ and λ^* and the shares of good and bad exporters η and η^* do not affect profits. The importer, however, has to pay the LC fee f^{LC}. While this payment takes place at the beginning of the transaction, sales revenues R are only realized after a time delay. Therefore, the importer has to pre-finance the fee at her interest rate $1+r^*$.[36] Similarly, before being paid, the exporter has to pre-finance her working capital K

[36] One concern about this assumption may be that banks incur some of the costs only later in the transaction. The LC fee paid upfront could then be invested by the banks. Under perfect competition in the banking sector, banks would then reduce the LC fee charged to importers by the interest they earn and the interest rate of the importer would not matter. While the assumption is a simplification that all costs arise in the beginning when the LC is issued and is made to keep the model tractable, a substantial fraction of paperwork and monitoring costs indeed arise at the beginning of an LC transaction. Furthermore, banks need to hold capital as long as they extend a guarantee. The cost of capital can thus be seen as uniformly distributed over the time interval. If we incorporated these points in the model, results would only change

at the source country interest rate $1+r$. Profits from a LC transaction thus decrease in the financing costs in both countries, $1+r$ and $1+r^*$, as well as in the LC fee f^{LC}.

When comparing the expected profits from the three financing forms in equations (3), (4) and (5), the tradeoffs involved in choosing between them are clear. Cash-in-advance and open account each eliminate the commitment problem on one side of the transaction. In contrast, a LC eliminates the risk on both sides but implies an additional cost in the form of the fee f^{LC}. The optimal choice of the exporter can be studied graphically. The left panel in figure 13 plots the profit factors of the three payment forms against destination country risk λ^*.[37] Cash-in-advance and a LC fully resolve the importers' commitment problem so that both profit factors are independent of destination country risk. Accordingly, profit factors are represented by two horizontal lines. Profits from open account decrease in destination country risk as illustrated by the downward-sloping line. Choosing the payment form with the highest profit factor, exporters, in our example, prefer open account when destination risk is low and a LC when this risk is high.

4.1.4 Letter of credit with endogenous fee

So far, the model corresponds to Schmidt-Eisenlohr (2013). We now endogenize the LC fee f^{LC}. Substitute $\tilde{\lambda} = \eta + (1-\eta)\lambda$ and $\tilde{\lambda}^* = \eta^* + (1-\eta^*)\lambda^*$ and assume that there is a competitive banking sector offering LCs.[38] The LC fee consists now of two components. First, the provision of a LC requires monitoring and administrative expenses by the issuing bank, which are proportional to the transaction value of the LC C^{LC}. Total monitoring costs are mC^{LC}. Second, the issuing bank defaults on its obligation with some probability. This probability is proportional to the risk of default in the destination country and is given by $\alpha(1-\tilde{\lambda}^*)$. This assumption is plausible because the default risk of a bank should, by and large, be determined by the risk conditions in the local market.

Given that the issuing bank might default on its obligations, there is scope for the exporter to ask her bank to confirm the LC.[39] Under perfect competition in the banking market, a confirming bank charges its expected loss from the guarantee $CC = \alpha(1-\lambda^*)C^{LC}$. Adding the monitoring and administrative costs to the expected loss from default, the total LC fee can be expressed as: $f^{LC} = m + \alpha(1-\tilde{\lambda}^*)$. Plugging this expression into equation (5),

quantitatively.

[37] Profit factors are defined as the expressions in front of R in the expected profits. These are sufficient for ordering the three payment contracts by their profitability. See the appendix of the online version for details.

[38] If banks had market power and charged a markup over their marginal cost of providing a LC, results would not change qualitatively. Markups would, however, magnify the effect of destination country risk on the cost of LCs.

[39] When a LC is confirmed, the risk of default by the issuing bank is transferred from the exporter to the confirming bank. Here, an exporter is risk neutral and is indifferent between LC confirmation and bearing the risk herself, as both choices imply the same expected profits and would lead to the same payment choice. Assume that, if indifferent, the exporter chooses a confirmed LC. Confirmation would be strictly preferred if exporters were risk averse.

expected profits are:

$$\Pi^{LC} = \frac{1}{(1+r)[1+(m+\alpha(1-\tilde{\lambda}^*))(1+r^*)]}R - K$$

As before, profits from a LC decrease both in the financing costs in the source country and in the destination country, $1+r$ and $1+r^*$. They now also depend on the default probability in the importer's country through the LC fee f^{LC}. The higher the default risk, the lower the profits under this contract choice.

The difference between an exogenous and an endogenous LC fee can be understood by comparing the left and the right graph of figure 13. The right graph plots profit factors against destination country risk λ^* for the case in which the LC fee is endogenous. The profit factors of cash-in-advance and open account are the same as in the original model shown in the left graph. However, LC profits now decline in destination country risk. Because banks are able to reduce risk, LC profits decline less steeply in destination country risk than open-account profits. Thus for low levels of destination country risk, open account remains the optimal choice. At intermediate levels of risk, LCs are preferred. When the risk in the destination country is high, exporters choose cash-in-advance.

4.2 Generating the results found in the data

4.2.1 Changes in aggregate risk

In the empirical section, we found that the use of bank guarantees increases when the Volatility Index rises. The VIX reflects both changes in global default risk as well as changes in uncertainty and risk aversion. In this model, all agents are risk neutral so the variance of profits does not play a role for financing decisions.[40] We therefore consider only how changes in global default risk affect the exporters' payment contract choice. Assume that the risks of non-delivery and non-payment in the source and the destination country, respectively, are both proportional to aggregate risk V.[41] Furthermore, define $\kappa_1 = \min\{\frac{1}{1+r^*}, \frac{1+r}{(1+r^*)^2}\frac{\tilde{\lambda}}{\tilde{\lambda}^*}\}$. Then, the following proposition can be derived.

Proposition 1 *Suppose that banks are sufficiently efficient in mitigating risk, that is* $\alpha < \kappa_1$. *Then, the use of LCs increases in aggregate risk.*
Proof. See the appendix of the online version. ■

As discussed before, a LC is able to resolve the commitment problem both in the source and in the destination country. Cash-in-advance and open account each only resolve the problem in one of the two countries. LCs are therefore best able to cope with a setting of high risk in the source and the destination country. If banks are sufficiently efficient at reducing risk (low α), LCs thus become more attractive when aggregate default risk increases.

[40] If exporters and importers were risk averse, then LCs would become more attractive when uncertainty and the default risk increase.

[41] That is, assume that $\tilde{\lambda}^* = \frac{\gamma^*}{V}$ and $\tilde{\lambda} = \frac{\gamma}{V}$.

4.2.2 Changes in aggregate financing costs

Next, consider the effect of a change in aggregate financing costs on the use of LCs. Let aggregate financing costs be denoted by L. Assume that this variable corresponds to a world wide base interest rate (like the Libor) and that it affects country level interest rates in an additive way.[42] Define $\kappa_2 = \left(\frac{1+r^*}{1+r}\right)^2 \frac{1+f^{LC}(1+r^*+1+r)}{(1+f^{LC}(1+r^*))^2}$ and $\kappa_3 = \frac{1+f^{LC}(1+r^*+1+r)}{(1+f^{LC}(1+r^*))^2}$. Then the following proposition holds:

Proposition 2 *Suppose $\tilde{\lambda} < \kappa_2$ and $\tilde{\lambda}^* < \kappa_3$.*[43] *Then, the use of LCs decreases in aggregate financing costs.*

Proof. See the appendix of the online version. ■

The preceding analysis revealed a drawback of LCs. They require pre-financing both in the source and in the destination country. The importer has to pre-finance the LC fee, and the exporter has to pre-finance the working capital. In comparison, cash-in-advance and open account only require pre-financing by one of the two parties. This generates the result stated in the proposition: if $\tilde{\lambda}$ and $\tilde{\lambda}^*$ do not exceed the thresholds κ_1 and κ_2, respectively, the use of LCs decreases when financing costs increase symmetrically in the two countries.

This result is illustrated in figure 14. As before, the x-axis denotes destination country risk and the y-axis shows the profit factors. The left panel depicts profit factors when global financing costs are low. In the right panel, all parameters are kept constant but financing costs in the two countries are increased by the same amount. First, note that this reduces the profitability of all three payment forms so that all three lines are shifted downward. Second, comparing the left and the right panel reveals that the profitability of LCs decreases by more than the profitability of its alternatives. The range of risk levels for which a LC dominates its alternatives becomes smaller.

The model abstracts from two additional channels that could generate a relationship between the cost of a LC and interest rates. First, depending on how likely a buyer is to default, the issuing bank may require her to make a cash deposit. Firms typically borrow the money for the deposit. Any difference between the borrowing rate and the interest firms receive on the deposit generates additional costs. This difference may increase with the Libor. Second, banks need to hold capital for each guarantee they extend. If interest rates rise, the cost of capital that banks face increases. To offset this effect, they may raise their LC fees. Both effects go in exactly the same direction as the mechanism included in the model and would therefore generate qualitatively the same result.

[42] That is, financing costs in the source country are $1 + r = 1 + \rho + L$ and costs in the destination country are $1 + \rho^* + L$, where ρ and ρ^* are country-specific financing cost factors.

[43] The conditions are quite weak. Anecdotal evidence suggests that LCs fees are in the low single digits. Setting $f^{LC} = 0.03$ and assuming real annual interest rates of about 10 percent ($1 + r = 1 + r^* = 1.025$) delivers an upper bound of 0.95 for the probability of default λ and λ^*. This value is even higher if the LC fee or interest rates are lower.

4.2.3 Hump shape in destination country risk

While the effects of aggregate financing costs and aggregate risk on the use of LCs can also be derived in the benchmark model in Schmidt-Eisenlohr (2013), the result that bank trade finance is hump-shaped in destination country risk, which is proven in the following, only holds with the modified LC fee.[44]

Proposition 3 *Suppose* $\alpha < \frac{1}{1+r^*}$ *and suppose that each contract type* $C \in \{CIA, OA, LC\}$ *is used for some* $\tilde{\lambda}^* \in [0,1]$. *Then, a LC has the highest relative profitability at intermediate values of* $\tilde{\lambda}^*$.

Proof. See the appendix of the online version. ■

Proposition 3 shows that the relative profitability of a LC as compared to the two alternatives changes in the destination country payment probability in a non-linear way. Figure 13 illustrated how profit factors change with destination country risk. As long as $\alpha < \frac{1}{1+r^*}$, the slopes in the right panel of the figure have the displayed ordering and a LC is most attractive for intermediate values of destination country risk.[45] With a fixed LC fee that does not depend on destination country risk (see the left panel of figure 13), the profitability of LCs would be independent of λ^*.

Figure 15 plots the difference between the profit factor of a LC and its best alternative. There is a kink at the maximum value, where a firm is indifferent between using cash-in-advance or open account as the second best contract. The observed hump-shaped relationship between the share of exports that are financed by LCs and destination country risk can be generated as follows. Assume that there is a continuum of exporters and importers in the source and the destination country. Assume further that each exporter draws a random additive shock to the profitability of LCs with a sufficiently large variance.[46] Then, there is always an exporter that is indifferent between a LC and an alternative payment method when trading with importers in a given destination country. As a consequence, the share of exporters that use LCs increases with the relative profitability of LCs. A hump-shaped relationship results.[47]

4.2.4 Heterogeneous responses

In the empirical section, we showed that the response to macroeconomic factors is heterogeneous across countries. More specifically, trade finance use adjusts the most in low and high risk countries and hardly moves at all in countries with intermediate levels of risk. In the following, we discuss how this can be rationalized by the model.

We know from proposition 3 that LCs are the most attractive for exports to countries of intermediate risk. For appropriately chosen parameters, a LC clearly dominates the two

[44] With a fixed LC fee, the condition that is needed for proposition 1 to hold simplifies.

[45] That is, expected profits from cash-in-advance, open account and LC change in the destination country payment probability $\tilde{\lambda}^*$ in the following way: $\frac{\partial \Pi^{OA}}{\partial \tilde{\lambda}^*} > \frac{\partial \Pi^{LC}}{\partial \tilde{\lambda}^*} > \frac{\partial \Pi^{CIA}}{\partial \tilde{\lambda}^*} = 0$. This is shown in corollary 1 in the appendix of the online version.

[46] Any single-peaked distribution with mean zero and a sufficiently large variance can be used.

[47] In Hoefele et al. (2012), shocks to the profitability of different payment forms are modeled explicitly.

alternative payment forms in these countries. The preference for LCs can be so large that movements in aggregate risk and financing costs may not change the choice of payment type at all. For destination countries with low and high risk this is different. Exporters that sell to these countries either prefer a different payment method or are close to being indifferent between using a LC or an alternative. Their contract choice is more elastic to macroeconomic factors and we observe more contract switching. In times when funding is cheap and aggregate risk is high, most firms use bank guarantees. However, in times when LCs are less attractive, exports to high and low risk countries are settled on open account or cash-in-advance terms.

To illustrate this point graphically, suppose that there is a mass of firms that are hit by random additive shocks to the profitability of LCs.[48] Furthermore, assume that parameters are such that most importers in countries with intermediate values of risk use LCs to finance trade transactions.[49]

Figure 16 shows a simulation of the model based on the following parameters: $m = .06, \quad \alpha = .2, \quad \tilde{\lambda} = .8, \quad r = r^* = .05 \quad \tilde{\lambda}^* \in [0.5, 1]$. It consists of two graphs. The left graph depicts the share of firms that choose LCs for different levels of country risk. For the solid line, the aggregate uncertainty factor is $V = 1$. For the dotted line, this factor is increased to $V = 1.05$. The right graph shows the change in LC use that is associated with the increase in risk, i.e. the difference between the two lines in the first graph. Note the correspondence between the left graph and figure 10. When risk increases, the share of trade finance increases in low and high risk countries and the hump shape gets flatter. The right graph generates the pattern documented in figure 8.

Figure 17 shows the share of firms that choose LCs for different interest rate environments. Simulations use the same parameter values as before. Now, instead of changing V, we vary L the global interest spread that is added to country level interest rates. We assume that this spread increases from 0 (solid line) to 0.05 (dotted line). In line with figure 11, the model predicts that low and high risk countries use LCs less and that the hump-shape becomes more pronounced. The right graph is the model equivalent to figure 9. An increase in the Libor leads to a response of trade finance that is hump-shaped in country risk. High and low risk countries reduce their trade finance substantially while intermediate risk countries hardly respond.

The simulations show that the model is able to replicate all relationships between trade finance, country risk and aggregate conditions. Under very weak conditions, the model predicts that the use of LCs is hump-shaped in destination country risk. Parameter require-

[48] We assume that shocks are distributed normal with mean zero and standard deviation 0.005.

[49] Survey data suggest that there is no country that uses LCs for 100 percent of their export transactions. How can this assumption be understood then? First, it is important to note that a large part of international trade is done intra-firm where LCs are typically not necessary. Second, a further part of trade may be long-run and firms may find each other sufficiently trustworthy to dispense of costly LC use. Third, some industries may use LCs more than others. For the mechanism to work, we hence need a weaker assumption: in intermediate risk countries a sufficient number of those firms that find LCs to be a viable option strictly prefers LCs. In other words, we require that in intermediate risk countries most firms that are doing arm's-length trade and are not in a long-run trade relationship and are in an industry that uses LCs use bank guarantees.

ments to generate the heterogeneous responses of trade finance to change in the VIX and the Libor across countries are more restrictive.[50]

5 Conclusions

This paper employs data from the U.S. to quantify the role of banks in trade finance and document new empirical patterns regarding the use of letters of credit across export destinations and over time. Trade finance is a large and highly concentrated business. It corresponds to roughly 20 percent of U.S. exports, with the top 5 banks extending more than 90 percent of the guarantees. The use of bank guarantees varies systematically with macroeconomic conditions and country characteristics. This has implications for trade costs, the transmission of financial shocks, and trade finance policy. We also show that the standard model of payment contract choice in international trade needs to be modified to account for all of the empirical relationships in the data.

Our first finding that the use of LCs changes systematically with global risk and funding conditions strongly suggests that variable trade costs (related to trade finance) are not stable over the business cycle but vary over time. This is in contrast to the traditional view on trade costs that arise from transport costs, geography and differences in culture, for example, and are either time-invariant or only move slowly over time. A second key finding is that the use of LCs does not adjust uniformly to global interest rate and risk movements. This implies that changes in macroeconomic factors may not only affect the level of trade but also its patterns in the short run through their differential effects on trade costs across countries. Variation in the use of trade finance across countries also suggests that the effect of financial shocks on trade is not uniform but depends on country characteristics.

Finally, trade finance is most prominent in exports to destination countries with intermediate risk. The fact that firms do not rely heavily on bank guarantees when selling to low risk countries is not surprising. LCs are expensive and if there is little risk that the importer defaults, open account is preferred. The low levels of trade finance observed in the riskiest countries may seem more puzzling. A common view of policy makers is that it is due to supply constraints. However, our model suggests otherwise. For very risky countries, LCs are expensive and firms optimally decide to use cash-in-advance instead. The data does not allow us to directly test for the relative importance of supply and demand factors. For policy interventions, it is crucial to distinguish between them, however. A further exploration of which firms, industries and countries are especially constrained in their access to bank guarantees and other trade finance instruments is a key question for future research.

[50] It is important to keep in mind that special parameters for the simulations are picked in order to generate the u-shaped response to change in the VIX and the hump-shaped response to changes in the Libor observed in the data. As explained in the main text, the basic mechanism should go through whenever countries with intermediate levels of risk use LCs for most of their import transactions.

A Data Appendix

Data sources

- Trade data: Quarterly trade data is from the IMF's Directions of Trade Statistics; yearly data is obtained by summing over 4 quarters.
- U.S. GDP: Quarterly numbers for the U.S. were taken from the national statistical agency via Haver Analytics' Data Link Express (DLX) Software.
- Nominal GDP per capita: Annual numbers are from the World Bank's World Development Indicators.
- Annual population: World Development Indicators.
- Share of export transported by vessel: Nominal U.S. merchandise imports and exports with information on modes of transport at 3-digit HS commodity code from Census Bureau Trade Data.
- Time to import: Doing Business Indicators from the World Bank.
- Distance: CEPII. For a description, see Mayer and Zignago (2005).
- Libor: 3-months rate downloaded from FRED economic data maintained by the Federal Reserve Bank of St. Louis; quarterly averages calculated from daily data.
- Fed funds rate: 3-months lending rate from Federal Reserve Bank of New York; quarterly averages calculated from daily data.
- VIX: Quarterly averages calculated from daily data downloaded from Bloomberg Terminal.
- EIU country risk: Quarterly index that combines banking, sovereign and currency risk, provided by the Economist Intelligence Unit, downloaded from Thomson Reuters Datastream.
- Alliant risk measure: Alliant is an insurance company that derives country risk scores from historical insurance loss data. The measure is an estimate of the likelihood that companies incur losses in the future; data downloaded from Bloomberg Terminal.
- Private credit by deposit money banks over GDP: Financial Structure Database provided by the World Bank. For a description, see Beck et al. (2009).
- SWIFT data: Information on the number of messages of type MT 700 received by U.S. banks and the underlying values of the messages was provided by the SWIFT Institute.

Variables

- Offshore Centers: Netherlands Antilles, United Arab Emirates, Bahrain, Bahamas, Belize, Bermuda, Barbados, Cayman Islands, Cyprus, Grenada, Hong Kong, Oman, Ireland, Jordan, Lebanon, Macao, Monaco, Maldives, Malta, Mauritius, Seychelles, Taiwan, Vanuatu, Samoa

B Background on the Data

The exact reporting instructions for the trade finance item in the FFIEC 009 Report are as follows:

"Report total extensions of credit with maturities one year and under [...] that: (1) are directly related to imports or exports and (2) will be liquidated through the proceeds of international trade. Provided these two conditions are met, such credit extensions may include customers' liability on acceptances outstanding, own acceptances discounted, acceptances of other banks purchased, pre-export financing where there is a firm export sales order, commercial LCs, as well as other loans and advances whenever such extensions directly relate to international trade. Include credit extensions for pre-export financing when there is a firm export sales order and the proceeds of the order will pay off indebtedness."

According to the definition, the data can capture several trade finance products that relate to U.S. exporting– in particular, LCs, loans to foreign importers, forfeiting and factoring. Trade financing of U.S. imports is possibly reflected in the data through loans and advances to foreign exporters. If U.S. banks finance third-party exports or imports, LCs, pre-export and pre-import loans as well as forfeiting and factoring could be included. The different forms of trade finance are discussed in more detail in the following.

Letters of credit LCs, described in detail in the main text, can show up in the dataset in two ways. First, a U.S. bank can confirm a foreign LC and thereby guarantee expected trade receipts. Second, it can issue a LC to a foreign importer, either directly or through an affiliate located abroad. In these cases, the U.S. bank guarantees obligations of the resident of a foreign country, and this is a contractual agreement that banks have to include in the FFIEC 009 report.

Trade finance loans Banks can also directly lend to exporters and importers to finance their trade transactions. If trading partners do not use bank guarantees, they typically agree to trade either on open account or cash-in-advance terms. In the former case, the exporter may obtain pre-financing from the bank, in the latter case the importer needs to finance the transaction. If a U.S. bank or its foreign affiliate lends to a foreign importer or a foreign exporter to pre-finance trade, it should be reported in the FFIEC 009 form.

Forfeiting and factoring If a U.S. exporting firm sells its goods to a foreign buyer on open account terms, this generates accounts receivable on its balance sheet. To raise working capital and to limit the exposure, it can decide to sell these accounts receivable to a financial institution at a discount. There are two options. If a firm sells the whole claim of a specific transaction, this is referred to as forfeiting. Alternatively, it can sell only a fraction of its accounts receivable, which is called factoring. In both cases, a financial institution takes over part of or all of the risk that the exporter would otherwise have to bear. If a U.S. bank participates in these activities, it receives a claim against a foreign buyer that is related to a trade transaction. Forfeiting and factoring should thus be captured in the data.

Table B.1: Different forms of bank trade finance and underlying trade transactions that are potentially captured in the data

	U.S. exports	U.S. imports	Third party trade
Pre-export financing	-	X	X
Pre-import financing (affiliate)	X	-	X
LC issuance (affiliate)	X	-	X
LC confirmation	X	-	X
forfeiting/ factoring	X	-	X

Table **??** summarizes the previous discussion, listing the different forms of bank trade finance, together with the underlying trade transactions that are potentially included in the data. To get a better understanding of the relative importance of import versus export financing, we begin by exploring relevant correlations in the data.

Table B.2: Country-level regressions, 1997-2011, quarterly frequency

	(1)	(2)	(3)	(4)	(5)	(6)
	all	all	non-offshore	non-offshore	offshore	offshore
$\log(\text{imp}_{ct})$	-0.0230	0.0959	0.0788	0.111	-0.365*	0.00481
	(0.0753)	(0.0715)	(0.0580)	(0.0799)	(0.175)	(0.143)
$\log(\text{exp}_{ct})$	0.756***	0.380***	0.663***	0.422***	0.994***	0.0307
	(0.0885)	(0.0731)	(0.0811)	(0.0743)	(0.191)	(0.275)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	Yes	No	Yes	No	Yes
Observations	6,828	6,828	6,006	6,006	822	822
R-squared	0.541	0.827	0.576	0.834	0.423	0.787

Note: This table analyzes the relationship between U.S. exports, U.S. imports and country-level trade finance claims. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by quarter and destination country. All regressions include a constant. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table **??** shows the results from OLS regressions where the log of quarterly aggregate trade finance claims at date t in country c is regressed on the log of imports from and the log of exports to country c in the same period. All columns include time-fixed effects. In odd columns, country-fixed effects are added. The estimated coefficients suggest that banks' trade finance claims are mainly driven by U.S. exports. Only the coefficient on exports is significant at standard significance levels. Moreover, the point estimate of the export coefficient is much larger than the estimate of the import coefficient. According to column 2, a 10 percent increase in exports makes the trade finance claims of U.S. banks rise by around 4 percent whereas the same change in imports increases claims by only 1 percent.

Table B.3: Third country relevance, country-level regressions, 1997-2011, quarterly frequency

	(1)	(2)	(3)	(4)
$\log(\text{imp}_{ct})$	0.00376	0.0646	-0.0321	0.0182
	(0.0735)	(0.0580)	(0.0739)	(0.0438)
$\log(\text{exp}_{ct})$	0.770***	0.281***	0.852***	0.246***
	(0.0955)	(0.0690)	(0.0902)	(0.0595)
$\log(\text{non-U.S. imp}_{ct})$	-0.00240	0.409***	-0.0527	0.173
	(0.160)	(0.155)	(0.162)	(0.172)
$\log(\text{non-U.S. exp}_{ct})$	-0.0564	0.0513	0.0391	-0.0335
	(0.132)	(0.128)	(0.141)	(0.119)
$\log(\text{GDPpc}_{cbt})$			-0.215**	0.931***
			(0.0899)	(0.232)
Time FE	Yes	Yes	Yes	Yes
Country FE	No	Yes	No	Yes
Observations	6,774	6,774	6,605	6,605
R-squared	0.538	0.827	0.559	0.833

Note: This table analyzes the relationship between non-U.S. trade and country-level trade finance claims. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by quarter and destination country. Non-U.S. imports are the imports of a destination country from all countries other than the U.S. Non-U.S. exports are the exports of a destination country to all countries other than the U.S. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Columns (3) to (6) of table **??** show the correlations between trade finance and imports and exports for offshore and non-offshore countries separately. While offshore countries' trade finance is significantly positively correlated with exports in the specification that only includes time-fixed effects, standard errors increase substantially and point estimates become much smaller when country-fixed effects are added in column 6. As the number of observations drops when offshore countries are considered exclusively, insignificant results could be due to the small sample size. However, the relationships documented in section 3 of the paper are stronger when offshore centers are excluded. This supports the hypothesis that most offshore trade finance claims are not linked to real activity but are driven by other factors.

U.S. banks could also be engaged in the financing of third-party trade. To test for this, the log of non-U.S. exports and imports from and to the destination country c are included as controls. Results are displayed in table **??**. All columns include time-fixed effects. In columns (2) and (4), country-fixed effects are added. The coefficient on non-U.S. imports

is significant in column (2), in which country-fixed are added. However, once the log of GDP per capita is controlled for, the coefficient on non-U.S. imports becomes insignificant at standard significance levels. We conclude from this that U.S. banks may also confirm LCs of foreign importers that trade with third parties but this does not explain much of the variation in the data.

Trade finance is a relationship intensive industry. Therefore, banks with foreign offices may have an advantage when providing trade finance to foreign firms. We find evidence for this in the data. First, we check whether a bank has more trade finance with a country if it has at least one foreign affiliate there. Thereto, the previous regression is now estimated at the bank-country level at a quarterly frequency, and a dummy is introduced that takes value 1 if a bank b has at least one foreign affiliate in country c at time t.[51] Second, we test whether the fact that a bank has affiliates in a given country increases the correlation between U.S. exports and U.S. imports and the bank's trade finance claims. To this end, interaction terms between the affiliate dummy and the log of imports and the log of exports, respectively, are included in the regression. The regression equation reads as follows:

$$\begin{aligned} \log(tf_{bct}) &= \beta_1 \log(imp_{ct}) + \beta_2 \log(exp_{ct}) + \beta_3 \text{affiliate}_{bct} + \beta_4 \text{affiliate}_{bct} \\ &\times \log(imp_{ct}) + \beta_5 \text{FDI dummy}_{bct} \times \log(exp_{ct}) + \alpha_b + (\alpha_c) + \alpha_{ct} + \epsilon_{bct} \quad \text{(B.1)} \end{aligned}$$

Table **??** reports the results. Columns (1) and (3) control for time- and bank-fixed effects. In columns (2) and (4), country×time-fixed effects are included in addition to bank-fixed effects.

Columns (1) and (2) display the results of regressions that only include the affiliate dummy. Its effect is positive and highly significant. Hence banks that have at least one foreign affiliate in a destination country have larger trade finance claims in that country.

In column (3), the interaction terms are added as regressors. The corresponding coefficients suggest that the trade finance claims of banks co-vary more with imports from a given country if the bank has a foreign affiliate in that country. The covariation between trade finance claims and U.S. exports, however, is not changed by a local presence of a bank. The results remain unchanged when country×time-fixed effects are included in column (4). This indicates that foreign offices supply financing in support of U.S. imports, that is, to foreign exporters. Loans to foreign importers by foreign affiliates seem to be less relevant.

These results together with the arguments made before imply that LCs and similar guarantees that support U.S. exports are the most important component in the data. Also included are pre-export loans extended to foreign firms that export to the U.S.

In addition to the previous analysis, we externally validate that the FFIEC 009 data mainly captures LCs. To that end, we obtain country-level data from the SWIFT Institute, which collects information on LC transactions world wide. The message type MT700 is sent by the issuing bank to the advising bank (in the U.S.) to indicate the terms and conditions of a documentary credit, which has been originated by the issuing bank. We have information

[51] Information on whether a bank has at least one foreign affiliate in a country is inferred from the FFIEC 009 report. The dummy takes value 1 if bank b has positive local assets or liabilities vis-a-vis residents of a country c in period t.

Table B.4: The effect of FDI on trade finance, bank-level regressions, 1997-2011

	(1)	(2)	(3)	(4)
$\log(\text{imp}_{ct})$	0.0445		-0.0319	
	(0.0302)		(0.0314)	
$\log(\text{exp}_{ct})$	0.241***		0.258***	
	(0.0370)		(0.0371)	
affiliate_{bct}	0.570***	0.689***	-0.469*	-0.464
	(0.0875)	(0.0840)	(0.259)	(0.319)
affiliate_{bct} * $\log(\text{exp}_{ct})$			-0.0363	-0.0304
			(0.0694)	(0.0806)
affiliate_{bct} * $\log(\text{imp}_{ct})$			0.176***	0.181***
			(0.0556)	(0.0667)
Time FE	Yes	No	Yes	No
Bank FE	Yes	Yes	Yes	Yes
Country × Time FE	No	Yes	No	Yes
Observations	33,922	35,134	33,922	33,922
R-squared	0.298	0.523	0.305	0.525

Note: This table analyzes the relationship between U.S. exports, U.S. imports, FDI by U.S. banks and bank-country-level trade finance claims. The dependent variable is the log of the trade finance claims of a U.S. bank by quarter and destination country. Affiliate is an indicator variable that takes a value of one if a bank b has positive local assets or liabilities vis--vis residents of country c in quarter t. Standard errors are clustered at the country-bank level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

on the number of messages sent from 2003 onwards at a quarterly frequency and on the total value of LCs confirmed by U.S. banks from the fourth quarter of 2010 onwards.

Table **??** shows that the total value of LCs in the SWIFT data in the forth quarter of 2010 corresponds to around 67 percent of the total value in the FFIEC 009 data.[52] The discrepancy between the SWIFT values and the FFIEC 009 values increases after 2010, which is in line with the view that the recent increase in U.S. banks' trade finance claims shown in figure 2 is due to U.S. banks' financing of trade between non-U.S. parties in regions that were served by European banks before the crisis. This recent development also suggests that before 2010 q4, the share of LCs in the FFIEC 009 data is at least 67 percent.

Columns (1) to (4) of table **??** report the results of regressions of the log of U.S. banks' trade finance claims on the log of the value of MT700 messages that U.S. banks received.

[52]Total amounts sent through SWIFT are higher than our observed total value because the SWIFT Institute cannot disclose amounts that are composed of less than four transactions.

Table B.5: Values in the FFIEC 009 data versus the SWIFT data in $million

year	quarter	FFIEC 009	SWIFT	SWIFT share
2010	4	51,994	34,872	0.67
2011	1	58,706	32,716	0.56
2011	2	62,071	34,522	0.56
2011	3	73,915	33,671	0.46
2011	4	76,585	34,374	0.45
2012	1	72,977	35,691	0.49
2012	2	74,420	32,833	0.44

Column (1) shows that the SWIFT amounts explain around 60 percent of the variation in the FFIEC 009 data. The SWIFT amounts are successful in explaining the cross-sectional variation (see column (3)) but they do not explain much of the within-country time variation in trade finance claims (see column (2)). However, when we use the number of SWIFT messages instead of the amounts (see columns (5) to (9)), available for a much longer time period from 2003 to 2012 (40 quarters), we see that the SWIFT data explains both variation across countries and over time successfully. Based on this additional exercise, we are confident that the FFIEC 009 data captures largely confirmed LCs in support of U.S. exports.

Table B.6: Using SWIFT data to predict FFIEC 009 data

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(SWIFT amounts$_{ct}$)	0.784***	0.0334	0.783***	0.0655*				
	(0.0246)	(0.0391)	(0.0245)	(0.0386)				
ln(# of SWIFT messages$_{ct}$)					0.778***	0.0848***	0.802***	0.289***
					(0.0121)	(0.0293)	(0.0121)	(0.0320)
Time FE	No	No	Yes	Yes	No	No	Yes	Yes
Country FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	835	835	835	835	4,641	4,641	4,641	4,641
R-squared	0.604	0.935	0.613	0.940	0.503	0.841	0.532	0.856

Note: This table analyzes the relationship between trade finance claims from the FFIEC 009 form and values of letter-of-credit messages from the SWIFT Institute. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by quarter and destination country. SWIFT amounts are the sum of the values of all MT700 messages (LC issuance) with the U.S. as counter-party by quarter and issuing country. The variable *# of SWIFT messages*$_{ct}$ represents the number of MT700 messages received by U.S. banks. Robust standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

C Robustness

An alternative measure of country risk An alternative measure of country risk comes from the Alliant Insurance Company. The firm provides an inverse measure of default risk, which reflects the likelihood that industries and companies experience future losses and which is derived from historical insurance loss data. This series is available from the fourth quarter of 2003 onwards. The higher this measure, the lower the risk of non-payment. While the EIU risk measure covers a larger time period, the Alliant risk measure is observed for a larger number of countries.

Table **??** tests for the relationship between default risk and trade finance claims using the Alliant risk measure. Standard errors are, in general, larger compared to table 3 but we still find a significant effect of risk on trade finance. The coefficients on the risk measure in columns (1) and (3) are highly significant and negative, suggesting that trade finance claims are lower in countries with a higher probability of repayment. When risk squared is added as regressor (see columns (2) and (4)), the risk coefficients are not significant at a 10 percent significance level. However, when GDP per capita is excluded from the regressions, which is highly correlated with country risk, there is evidence of a hump-shaped response.

Tables **??** and **??** are equivalent to tables 5 and 6, respectively. The coefficients related to the Alliant risk measure confirm that the responses to changes in the VIX and the Libor are heterogeneous across countries. The standard errors are again larger than in the regressions presented in the main text but there is also evidence for a u-shaped response to changes in the VIX and a hump-shaped response to change in the Libor based on this alternative index.

Controlling for financial development Firms may have a choice between using a U.S. bank or a bank in the other trading partner's country to finance a transactions. If this ability to substitute is correlated with the independent variables, the regressions may suffer from an omitted variable bias. To account for this, we include private credit over GDP, available from the Financial Structure Database of the World Bank, in the estimations. Table **??** presents the results. The coefficient of financial development is significant if country-fixed effects are not included, indicating that trade finance claims are lower in countries with higher ratios of private credit over GDP. This suggests that there is a substitution effect and that trading partners use non-U.S. banks more when the non-U.S. party is located in a country with a developed banking sector. However, including this variable does not affect our results qualitatively. All coefficients of interest are significant and have signs and magnitudes that are consistent with the previous findings.

Semi-parametric estimation techniques to test for the relationship between trade finance and risk To check that the hump-shaped relationship between trade finance and country risk that we find is not due to the fact that we do not allow for a more flexible form, we employ Robinson's (1988) double residual estimator. The log of distance and the log of exports enter the regression linearly, country risk enters non-linearly. Precisely:

$$\log(tf_{ct}) = \beta_0 + \beta_1 \log(\exp_{ct}) + \beta_2 \log(\text{distance}_c) + f(\text{risk}_{ct}) + \epsilon_{ct} \tag{C.1}$$

The power of non-parametric estimation techniques is limited given our small sample size. However, the semi-parametric estimation is a useful check. The upper panel of figure **??** shows the relationship between trade finance claims and risk that we obtain based on annual data. In the lower panel, only the years 2007, 2008 and 2009 are included in the sample. Both figures largely confirm that banks' trade finance claims are hump-shaped in destination country risk. In fact, based on Hardle and Mammen's (1993) specification test, we cannot reject the hypothesis that the non-parametric estimates are the same as the parametric estimates with polynomials of degree 2.

Table C.1: The effect of country risk on bank trade finance, Alliant risk measure, annual frequency

	(1) OLS	(2) OLS	(3) IV	(4) IV
$\log(\exp_{ct})$	1.002***	0.999***	1.175***	1.186***
	(0.0621)	(0.0621)	(0.0882)	(0.0858)
$\log(\text{distance}_c)$	0.469*	0.479**	0.601**	0.621***
	(0.240)	(0.216)	(0.254)	(0.235)
$\log(\text{GDPpc}_{cbt})$	-0.130	-0.0764	-0.298**	-0.261*
	(0.128)	(0.136)	(0.146)	(0.149)
repayment_{ct}	-0.0166*	0.0338	-0.0148*	0.0338
	(0.00860)	(0.0289)	(0.00867)	(0.0289)
repayment^2_{ct}		-0.000490*		-0.000472
		(0.000287)		(0.000289)
Observations	821	821	821	821
R-squared	0.657	0.664	0.643	0.648

Note: This table reports robustness checks employing an alternative risk measure from the Alliant Insurance Company. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by year and destination country. Repayment is an index created by the Alliant Insurance Company. It is based on historical insurance loss data and is higher if expected future losses for companies are lower. All columns include time-fixed effects. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table C.2: Heterogeneous responses to changes in the VIX, Alliant risk measure, quarterly frequency

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) IV	(6) IV	(7) IV	(8) IV
$\log(\text{exp}_{ct})$	0.278***	0.267***	0.282***	0.272***	0.875*	1.300*	0.886*	1.330*
	(0.0796)	(0.0851)	(0.0800)	(0.0853)	(0.483)	(0.750)	(0.489)	(0.760)
$\log(\text{VIX}_t)$	-0.424**		0.0791		-0.478**		0.160	
	(0.183)		(0.443)		(0.186)		(0.424)	
$\log(\text{Libor}_t)$	0.00447		0.00448		0.00260		0.00256	
	(0.0335)		(0.0334)		(0.0340)		(0.0340)	
$\log(\text{GDPpc}_{cbt})$	0.407**	0.531*	0.420***	0.553**	-0.187	0.0840	-0.177	0.110
	(0.160)	(0.278)	(0.159)	(0.275)	(0.513)	(0.474)	(0.516)	(0.471)
repayment_{ct}	-0.0389*	-0.0424**	0.0267	0.0223	-0.0508**	-0.0721**	0.0321	0.0271
	(0.0205)	(0.0212)	(0.0606)	(0.0616)	(0.0241)	(0.0337)	(0.0575)	(0.0600)
repayment^2_{ct}	0.000224	0.000230	-0.000376	-0.000365	0.000308	0.000352	-0.000453	-0.000563
	(0.000258)	(0.000261)	(0.000614)	(0.000616)	(0.000268)	(0.000291)	(0.000578)	(0.000586)
$\text{repayment}_{ct} * \log(\text{VIX}_t)$	0.00981***	0.0104***	-0.0122	-0.0113	0.0101***	0.0135***	-0.0178	-0.0199
	(0.00352)	(0.00342)	(0.0181)	(0.0184)	(0.00343)	(0.00417)	(0.0175)	(0.0187)
$\text{repayment}^2_{ct} * \log(\text{VIX}_t)$			0.000202	0.000200			0.000257	0.000309*
			(0.000166)	(0.000167)			(0.000162)	(0.000175)
Time FE	No	Yes	No	Yes	No	Yes	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,793	2,793	2,793	2,793	2,776	2,776	2,776	2,776
R-squared	0.882	0.883	0.882	0.884	0.870	0.855	0.870	0.854

Note: This table reports robustness checks employing an alternative risk measure from the Alliant Insurance Company. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by quarter and destination country. Repayment is an index created by the Alliant Insurance Company. It is based on historical insurance loss data and is higher if expected future losses for companies are lower. Global risk is proxied by the VIX index. Country risk is proxied by the Economist Intelligence Unit risk index. Columns (1) to (4) report results from OLS regressions. Columns (5) and (8) report results from IV regressions. There, the log of domestic absorption in the destination country instruments the log of exports. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table C.3: Heterogeneous responses to changes in the LIBOR, Alliant risk measure, quarterly frequency

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) IV	(6) IV	(7) IV	(8) IV
$\log(\exp_{ct})$	0.499***	0.381***	0.507***	0.390***	0.748***	1.532***	0.763***	1.584***
	(0.0832)	(0.102)	(0.0821)	(0.100)	(0.151)	(0.480)	(0.150)	(0.480)
$\log(VIX_t)$	0.0445		0.0447		0.0159		0.0153	
	(0.0604)		(0.0604)		(0.0635)		(0.0631)	
$\log(Libor_t)$	0.235***		0.0419		0.324***		0.0188	
	(0.0870)		(0.180)		(0.0906)		(0.174)	
$repayment_{ct}$	-0.0247	-0.0236	-0.0285	-0.0273	-0.0268	-0.0462*	-0.0350*	-0.0571**
	(0.0255)	(0.0271)	(0.0253)	(0.0268)	(0.0202)	(0.0252)	(0.0197)	(0.0257)
$repayment^2_{ct}$	0.000429	0.000459	0.000477	0.000506	0.000454*	0.000575**	0.000550**	0.000700**
	(0.000339)	(0.000352)	(0.000335)	(0.000348)	(0.000251)	(0.000282)	(0.000245)	(0.000284)
$repay._{ct}$ * $\log(Libor_t)$	-0.00530***	-0.00515***	0.00318	0.00327	-0.00614***	-0.00771***	0.00723	0.00898
	(0.00159)	(0.00159)	(0.00725)	(0.00741)	(0.00160)	(0.00181)	(0.00699)	(0.00728)
$repay.^2_{ct}$ * $\log(Libor_t)$			-0.0000792	-0.0000787			-0.000125*	-0.000157**
			(0.0000671)	(0.0000683)			(0.0000653)	(0.0000700)
Time FE	No	Yes	No	Yes	No	Yes	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,118	3,118	3,118	3,118	2,809	2,809	2,809	2,809
R-squared	0.877	0.880	0.877	0.880	0.874	0.844	0.874	0.842

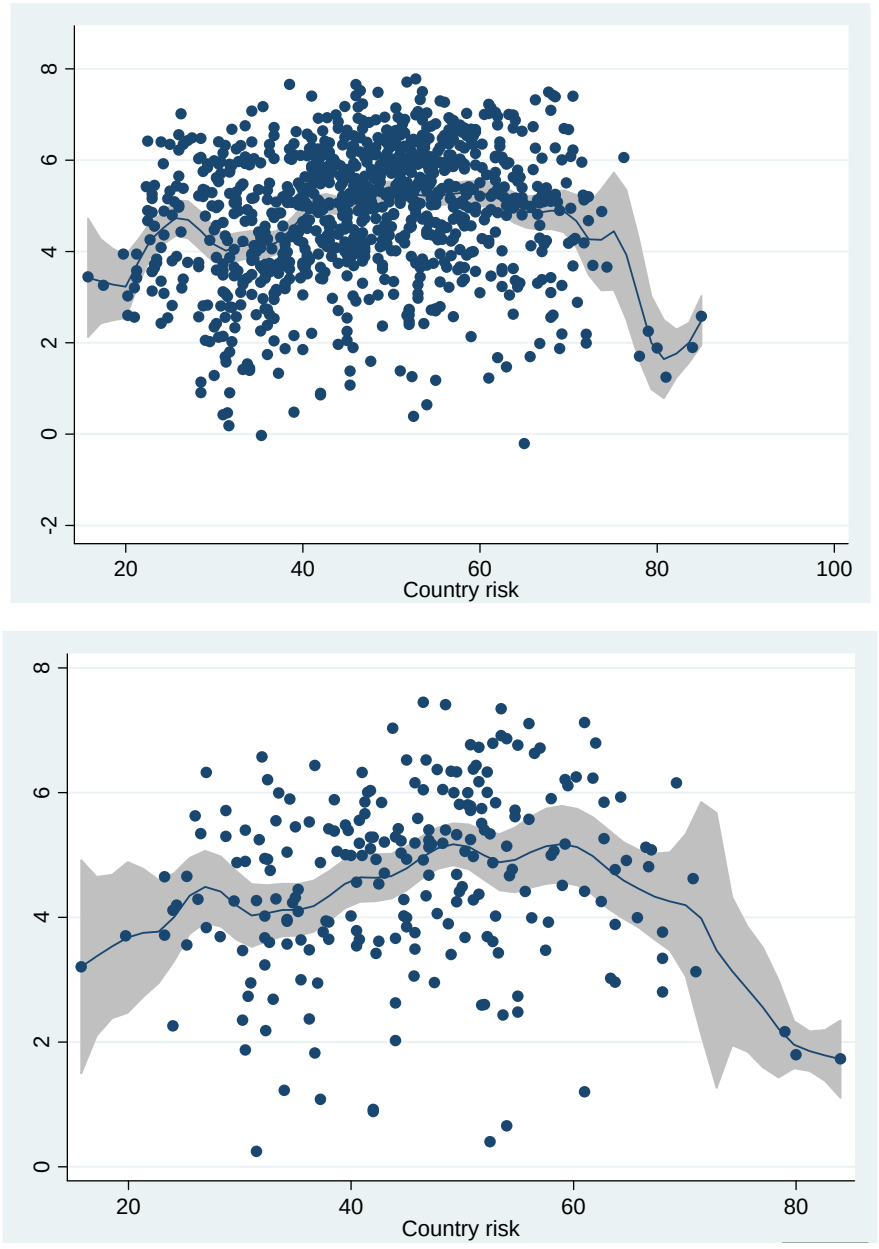
Note: This table reports robustness checks employing an alternative risk measure from the Alliant Insurance Company. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by quarter and destination country. Repayment is an index created by the Alliant Insurance Company. It is based on historical insurance loss data and is higher if expected future losses for companies are lower. Global financing costs are proxied by the Libor. Country risk is proxied by the Economist Intelligence Unit risk index. Columns (1) to (4) report results from OLS regressions. Columns (5) and (8) report results from IV regressions. There, the log of domestic absorption in the destination country instruments the log of exports. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table C.4: Private credit over GDP as additional control, annual frequency

	(1)	(2)	(3)
$\log(\exp_{ct})$	1.098***	1.050***	0.474**
	(0.0561)	(0.0744)	(0.235)
$\log(\text{distance}_{c})$	0.787***	0.157	
	(0.235)	(0.265)	
$\log(\text{time to import}_{ct})$	0.689***		
	(0.252)		
$\log(\text{GDPpc}_{cbt})$	-0.112	-0.306*	0.914***
	(0.116)	(0.162)	(0.339)
risk_{ct}		0.0929*	0.103*
		(0.0556)	(0.0540)
risk^2_{ct}		-0.00116**	-0.000984*
		(0.000519)	(0.000564)
private credit/GDP_{ct}	-0.000836	-0.00880*	0.00451
	(0.00262)	(0.00463)	(0.00631)
Time FE	Yes	Yes	Yes
Country FE	No	No	Yes
Observations	503	789	789
R-squared	0.692	0.642	0.883

Note: This table reports robustness checks controlling for private credit over GDP of the destination country. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by year and destination country. Time to trade is proxied by distance to the U.S. and by the time to import from the World Bank Doing Business Indicators. Country risk is proxied by the Economist Intelligence Unit risk index. Private credit over GDP is from the Financial Structure Database of the World Bank. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Figure C.1: Non-parametric estimation of the relationship between trade finance and country risk



Note: The two graphs show the relationship between the log of trade finance claims and country risk that is estimated using semi-parametric techniques. The upper panel includes all years in the sample. The lower panel only includes the years from 2007 until 2009.

D Additional Analysis at the Bank-Level

D.1 More bank-level statistics

In the following, we asses the importance of the trade finance business for U.S. banks. In the first quarter of 2012, total trade finance claims corresponded to approximately one percent (0.72 percent) of the foreign assets, guarantees and unused commitments of all FFIEC reporting banks (including those with zero trade finance claims). This figure masks that, for some banks, the trade finance business is an important part of their foreign operations.

Table **??** shows statistics for banks with positive trade finance claims in the respective quarter. In early 2006, the 21 active firms had claims of $1038 million on average. Claims increased to an average of $3853 million in 2012 for the 19 remaining banks. The average share of trade finance claims in total foreign assets, unused commitments and guarantees of each bank decreased from 12.8 percent to 9.4 percent over the same period. On average, trade finance claims as the share of each bank's total balance sheet increased.

Table D.1: Importance of trade finance business for U.S. banks

	trade finance in $mio	share in total assets	share in foreign assets
		2006 q1	
N	21	21	21
mean	1038.1	.00121	12.76
sd	2254.1	.00168	18.95
		2012 q1	
N	19	19	19
mean	3852.6	.00161	9.39
sd	7360.0	.00248	14.40

D.2 Exports, time to trade and country risk as triggers of entry

In this section, we investigate whether the same factors that determine trade finance in the aggregate, also trigger entry by banks into markets and systematically affect concentration at the country-level. We consider three measures of entry and concentration that address different moments of the within-country bank distribution: the number of banks active, the size of the smallest bank active, and the share of the largest three trade finance providers in total trade finance in a given country.

The number of active banks directly captures the extensive margin of banking. The second variable allows us to analyze whether there is a pecking order, i.e., whether there is a systematic relationship between bank size and entry. The size of bank b is measured by the total trade finance claims of bank b in country c at time $t-1$. A standard model would suggest that the largest, most productive banks enter most markets. Smaller banks should only be active in markets that are sufficiently large and profitable. The third measure is a

direct measure of concentration. For each country, we compute the share of the three banks with the largest trade finance claims in total claims. If small banks that enter a market are able to attract a significant market share, then the share of the top 3 banks should be low.

The three dependent variables are regressed on country observables that affect the aggregate volume of trade finance as we have shown: time to trade, risk and exports. In addition, nominal GDP per capita is included in the regressions to control for other factors that may affect entry. Specifically, the regressions take the following form:

$$y_{ct} = \beta_1 \log(\text{exp}_{ct}) + \beta_2 \log(\text{GDPpc}_{ct}) + \beta_3 \log(\text{distance}_c) + \\ + \beta_4 \text{sea share}_{ct} + \beta_5 \text{risk}_{ct} + \beta_6 (\text{risk}_{ct})^2 + \alpha_t + \epsilon_{ct}, \tag{D.1}$$

where y_{ct} stands either for the number of banks, the minimum bank size or the share of the top 3 banks. We report results of regressions based on annualized data in table **??**.[53] OLS regressions are displayed in odd columns, IV results in even columns. All regressions include time-fixed effects. Standard errors are clustered at the country level.

Number of banks Column (1) of table **??** shows regression results where the dependent variable is the log of the number of banks active in each market. The positive and significant coefficient on exports suggests that, as expected, the number of banks that have positive trade finance claims in a given market increases with the goods that the country imports from the U.S. Results are essentially identical when the log of exports is instrumented by the log of population, shown in column (2).

Two proxies of the time to trade, distance and the share of goods shipped by sea, are included in the regressions. Both variables should have a positive effect on the number of active banks because they increase the market size. Distance, however, also affects the fixed costs that firms face when operating in a foreign market. The further away a country is, the less familiar U.S. banks may be with the business environment and the more costly it may be to acquire information.[54] Thus distance has potentially two countervailing effects on profitability. The estimated distance coefficients in columns (1) and (2) are positive but insignificant suggesting that both described forces are at play. In contrast, the share of goods shipped by sea has a positive and significant effect on the number of banks, consistent with the idea that larger markets attract more banks.[55]

The third factor that affects market size is risk. As shown, the market for trade finance is largest for intermediate levels of risk. In line with these findings, the coefficients on risk and risk squared indicate that the number of banks that operate in a given market is largest for intermediate levels of risk.[56]

[53] Results are basically identical when estimated with the quarterly data and are therefore omitted.

[54] For example, Felici and Pagnini (2008) find evidence that distance is a barrier to entry in the Italian banking market.

[55] We do not present regressions result where the time to import from the Doing Business Indicators is included. Estimated coefficients on time to import have the expected signs but are significant only at a 15 to 20 percent significance level.

[56] First stage regression results are suppressed. As in the IV regression shown in the main text, the log of population is highly significant and the R^2 of the first stage is high.

Table D.2: Determinants of entry into the trade finance business

	number of banks		minimum bank size		share of top 3 banks	
	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
$\log(\text{exp}_{ct})$	0.364***	0.365***	-0.888***	-0.823***	-0.0418***	-0.0254**
	(0.0235)	(0.0292)	(0.0725)	(0.112)	(0.00740)	(0.0108)
$\log(\text{distance}_{c})$	0.0483	0.0489	0.470*	0.502*	0.0920***	0.100***
	(0.0781)	(0.0778)	(0.282)	(0.288)	(0.0324)	(0.0306)
sea share_{ct}	0.548**	0.549**	-0.700	-0.670	-0.110	-0.104
	(0.231)	(0.226)	(0.777)	(0.776)	(0.0751)	(0.0706)
$\log(\text{GDPpc}_{cbt})$	-0.0508	-0.0515	0.216	0.184	-0.0251	-0.0346*
	(0.0466)	(0.0476)	(0.161)	(0.171)	(0.0181)	(0.0199)
risk_{ct}	0.0234	0.0233	-0.119*	-0.118*	-0.0128**	-0.0133**
	(0.0188)	(0.0185)	(0.0621)	(0.0607)	(0.00585)	(0.00594)
risk^2_{ct}	-0.000374**	-0.000374**	0.00151**	0.00151**	0.000121**	0.000127**
	(0.000174)	(0.000172)	(0.000633)	(0.000622)	(0.0000543)	(0.0000548)
Observations	463	463	443	443	450	450
R-squared	0.744	0.744	0.553	0.550	0.313	0.297

This table analyzes the relationship between U.S. exports, time to trade, country risk and three measures of bank entry and concentration. The dependent variable in columns (1) and (2) is the number of banks with positive trade finance claims in destination country c and year t. In columns (3) and (4), it is the size of the smallest bank with positive trade finance claims in country c and year t. In columns (5) and (6), it is the share of the top three trade finance providers in total trade finance claims in country c and year t. Sea share is the share of goods transported by vessel to a destination in total exports. Country risk is proxied by the Economist Intelligence Unit risk index. Odd columns report results from OLS regressions. Even columns report results from IV regressions, in which the log of population in the destination country instruments the log of exports. All regressions include time-fixed effects. Standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Minimum bank size Next, we study how the size of the smallest bank active in a market varies with country characteristics. An increase in market size should make entry more attractive. Hence, smaller banks should serve larger export destinations. Columns (3) and (4) of table **??** show the results of regressions with minimum bank size as the dependent variable.[57] The signs on the coefficients of interest should be the opposite to those in columns (1) and (2) where the number of banks is the regressand. This is indeed the case. The effect of exports on the minimum size is negative suggesting that the size of the smallest bank decreases with U.S. exports to this market. The coefficient on the share of goods transported by ship also has the expected sign although it is not significant at standard significance levels. The effect of distance is positive and significant. The further away a country from the U.S., the larger the smallest bank that operates in that market. The fixed cost effect seems to dominates the effect of distance on market size. The signs on the variables risk and risk squared are fully in line with the argument that a larger market size triggers entry: The size of the smallest active bank is smallest in countries with intermediate levels of risk. This pattern also holds when exports are instrumented by population.

Share of the top 3 Finally, we look at concentration as an outcome variable. It is measured by the share of the top 3 banks in each destination market. Consistent with the results on minimum bank size, we find that the largest players are more important in countries to which the U.S. exports less. This can be seen from the negative and highly significant coefficient on exports in columns (5) and (6) of table **??**. As in columns (3) and (4), the distance coefficient is significant and positive, which again suggests that distance is a barrier to entry. The share of goods shipped by sea, in contrast, reduces concentration. The relationship between risk and concentration is also as expected: the share of the top 3 banks is lowest in countries with intermediate levels of risk.

These results imply that the same factors that drive the volume of trade finance in the aggregate also determine the extensive margin of trade finance and concentration. The larger the market for trade finance is, the larger is the number of operating banks, the smaller is the smallest bank active and the smaller is the market share of the top 3 banks. The fact that bank entry follows a pecking order so that larger banks operate in the smaller markets is a strong indication that fixed entry costs play a key role in the trade finance activities of banks.

[57] Similar to an approach in Yeaple (2009), who explores FDI by manufacturing firms, Niepmann (2013) also uses the minimum size of banks in a given country to study bank entry into foreign markets.

E Derivation of the Model

In the following, we derive the optimal contract choice between cash-in-advance, open account and LC for the baseline model with fixed LC fee f^{LC}. The model corresponds to the theory in Schmidt-Eisenlohr (2013). δ, the parameter that captures enforcement costs in the original model, is set to zero. For more details, including an extensive discussion of the underlying assumptions, see Schmidt-Eisenlohr (2013).

E.1 Cash-in-advance

There are two possible cases: a pooling case and a separating case. In the following, we first derive the optimal decision under pooling. We then study the separating case and derive the condition that assures pooling that is given in the main text.

Pooling case Under pooling, the exporter maximizes her expected profits, respecting the participation constraint of the importer. Expected profits between good and bad exporters differ because bad exporters are only forced to produce with probability λ:

$$\text{Good type: } \max_C \mathrm{E}\left[\Pi_{E,g}^{CIA,p}\right] = C^{CIA,p} - K, \tag{E.1}$$

$$\text{Bad type: } \max_C \mathrm{E}\left[\Pi_{E,b}^{CIA,p}\right] = C^{CIA,p} - \lambda K, \tag{E.2}$$

$$\text{s.t.}$$

$$\mathrm{E}\left[\Pi_{I}^{CIA,p}\right] = \frac{\eta + (1-\eta)\lambda}{1+r^*}R - C^{CIA,p} \geq 0, \tag{E.3}$$

$$\text{(participation constraint importer)}$$

$$\mathrm{E}\left[\Pi_{E,g}^{CIA,p}\right] = C^{CIA,p} - K \geq 0. \tag{E.4}$$

$$\text{(participation constraint good exporter)}$$

The optimal payment $C^{CIA,p}$ and optimal expected profits of a good and bad exporter, respectively, are:

$$C^{CIA,p} = \frac{\eta + (1-\eta)\lambda}{1+r^*}R, \tag{E.5}$$

$$\text{Good type: } \mathrm{E}\left[\Pi_{E,g}^{CIA,p}\right] = \frac{\eta + (1-\eta)\lambda}{1+r^*}R - K, \tag{E.6}$$

$$\text{Bad type: } \mathrm{E}\left[\Pi_{E,b}^{CIA,p}\right] = \frac{\eta + (1-\eta)\lambda}{1+r^*}R - \lambda K. \tag{E.7}$$

Separating First, note that if a good exporter chooses cash-in-advance, a bad exporter always chooses it as well and imitates the good type. This is strictly preferable to revealing her type as a higher pre-payment is received at no additional cost. If, however, good firms do not choose cash-in-advance, a bad firm might want to deviate and choose this contract.

This case is considered in the following.
Suppose a good exporter does not choose cash-in-advance. Given the ability to default on the contract, a bad firm might still consider it optimal to offer a cash-in-advance contract, even though this implies revelation of her type. In this case, the importer understands that she deals with a bad firm and adjusts her expected revenue downwards. Her participation constraint becomes:

$$\mathrm{E}\left[\Pi_I^{CIA,s}\right] = \frac{\lambda}{1+r^*}R - C^{CIA,s} \geq 0. \tag{E.8}$$

The pre-payment that makes the participation constraint of the importer bind is:

$$C^{CIA,s} = \frac{\lambda}{1+r^*}R. \tag{E.9}$$

The expected profit of a bad exporter in the separating case with CIA is thus:

$$\mathrm{E}\left[\Pi_{E,b}^{CIA,s}\right] = \frac{\lambda}{1+r^*}R - \lambda K. \tag{E.10}$$

A sufficient condition for the bad exporter not to choose cash-in-advance is that her expected profits in the separating case are less than the expected profits of a good firm in the pooling case. That is if:

$$\mathrm{E}\left[\Pi_{E,g}^{CIA,p}\right] > \mathrm{E}\left[\Pi_{E,b}^{CIA,s}\right]. \tag{E.11}$$

Substituting the expected profits into the inequality above and rearranging delivers the condition from the main text:

$$\frac{R}{K} > \frac{1+r^*}{\eta}. \tag{E.12}$$

E.2 Open account

Now, the exporter can choose between a pooling and a separating strategy. Pooling refers to the case where good and bad importers accept the proposed contract. In the separating case, only bad importers agree to buy the goods at the offered price. In the following, both cases are analyzed and then the pooling condition is derived.

Pooling case

$$\max_C \mathrm{E}\left[\Pi_E^{OA}\right] = \frac{\eta^* + (1-\eta^*)\lambda^*}{1+r}C^{OA} - K, \tag{E.13}$$

s.t.

$$\mathrm{E}\left[\Pi_{I,g}^{OA}\right] = R - C^{OA} \geq 0 \tag{E.14}$$

(participation constraint good importer).

It is optimal for the exporter to choose C^{OA} such that the participation constraint of the good importer binds. This implies:

$$C^{OA} = R, \tag{E.15}$$

$$\mathrm{E}\left[\Pi_E^{OA}\right] = \frac{\eta^* + (1-\eta^*)\lambda^*}{1+r} R - K. \tag{E.16}$$

Separating The separating case implies the following participation constraint for a bad importer:

$$\mathrm{E}\left[\Pi_{I,b}^{OA,s}\right] = \frac{R - \lambda^* C^{OA}}{1+r^*} \geq 0. \tag{E.17}$$

A binding participation constraint of a bad importer implies:

$$C^{OA,s} = \frac{R}{\lambda^*}. \tag{E.18}$$

The prepayment C^{OA} exactly offsets the risk of non-payment by the importer. In expectation the importer thus pays R to the exporter. Expected profits of the exporter are, however, reduced as good importers reject the contract and only bad importers (share $1-\eta^*$) accept it. Thus expected profits are:

$$\mathrm{E}\left[\Pi_E^{OA,s}\right] = (1-\eta^*)\left(\frac{1}{1+r}R - K\right). \tag{E.19}$$

Comparing profits, an exporter strictly prefers a pooling contract if:

$$\frac{R}{K} > \frac{\eta^*(1+r)}{\eta^* - (1-\eta^*)(1-\lambda^*)}. \tag{E.20}$$

E.3 Letter of credit

Under the maintained assumption of perfect third party verifiability, with a LC, the commitment problem between the exporter and the importer is fully resolved. The maximization problem is:

$$\max_C \mathrm{E}\left[\Pi_E^{LC}\right] = \frac{C^{LC}}{1+r} - K, \tag{E.21}$$

$$\text{s.t. } \mathrm{E}\left[\Pi_I^{LC}\right] = \frac{R - C^{LC}}{1+r^*} - f^{LC} C^{LC} \geq 0 \quad \text{(participation constraint importer)}. \tag{E.22}$$

In the optimum, the participation constraint of the importer binds. The optimal payment and expected profits are:

$$C^{LC} = \frac{R}{1 + f^{LC}(1 + r^*)}, \tag{E.23}$$

$$\Pi_E^{LC} = \frac{R}{(1 + f^{LC}(1 + r^*))(1 + r)} - K \tag{E.24}$$

F Proofs

Profit factors First, note that to compare the attractiveness of the three payment contracts, it is sufficient to compare the expression in front of R, which, in the following, is denoted by π and is called the profit factor.[58] The profit factors under the three payment forms are:

$$\pi^{CIA} = \frac{\tilde{\lambda}}{1+r^*} \tag{F.1}$$

$$\pi^{OA} = \frac{\tilde{\lambda}^*}{1+r} \tag{F.2}$$

$$\pi^{LC} = \frac{1}{(1+r)[1+(m+\alpha(1-\tilde{\lambda}^*))(1+r^*)]} \tag{F.3}$$

Proof of proposition 1 **Proof.** From before, $\tilde{\lambda}^* = \frac{\gamma^*}{V}$ and $\tilde{\lambda} = \frac{\gamma}{V}$. The difference between the profit factors of cash-in-advance and LC is:

$$\pi^{CIA} - \pi^{LC} = \frac{\gamma}{V(1+r^*)} - \frac{1}{(1+r)[1+(m+\alpha(1-\gamma^*/V))(1+r^*)]} \tag{F.4}$$

Taking the derivative with respect to V gives:

$$\frac{\partial\left(\pi^{CIA} - \pi^{LC}\right)}{\partial V} = -\frac{\gamma}{V^2(1+r^*)} - \frac{(1+r^*)\alpha\gamma^*/V^2}{(1+r)^2[1+(m+\alpha(1-\gamma^*/V))(1+r^*)]^2} \tag{F.5}$$

The derivative is smaller than zero if:

$$\alpha < \frac{1+r}{(1+r^*)^2}\frac{\tilde{\lambda}}{\tilde{\lambda}^*}[1+f(1+r^*)]^2 \tag{F.6}$$

Note that $f \geq 0$. A sufficient condition is thus:

$$\alpha < \frac{1+r}{(1+r^*)^2}\frac{\tilde{\lambda}}{\tilde{\lambda}^*} \tag{F.7}$$

The difference between the profit factors of open account and LC is:

$$\pi^{OA} - \pi^{LC} = \frac{\gamma^*}{V(1+r)} - \frac{1}{(1+r)[1+(m+\alpha(1-\gamma^*/V))(1+r^*)]} \tag{F.8}$$

Taking the derivative with respect to V gives:

$$\frac{\partial\left(\pi^{OA} - \pi^{LC}\right)}{\partial V} = -\frac{\gamma^*}{V^2(1+r)} - \frac{(1+r^*)\alpha\gamma^*/V^2}{(1+r)^2[1+(m+\alpha(1-\gamma^*/V))(1+r^*)]^2} \tag{F.9}$$

[58] These factors are sufficient because under pooling the equilibrium contract only depends on the optimal choice of good exporters. Bad exporters imitate whichever contract is optimally chosen by good firms.

The derivative is smaller than zero if:

$$\alpha < \frac{1}{1+r^*}[1+f(1+r^*)]^2 \tag{F.10}$$

Note that $f \geq 0$. A sufficient condition is thus:

$$\alpha < \frac{1}{1+r^*} \tag{F.11}$$

■

Proof of proposition 2 **Proof.** From before, $(1+r) = 1+\rho+L$, and $1+r^* = 1+\rho^*+L$. Then the profit factors are:

$$\pi^{CIA} = \frac{\tilde{\lambda}}{1+\rho^*+L} \tag{F.12}$$

$$\pi^{OA} = \frac{\tilde{\lambda}^*}{1+\rho+L} \tag{F.13}$$

$$\pi^{LC} = \frac{1}{(1+\rho+L)[1+f^{LC}(1+\rho^*+L)]} \tag{F.14}$$

Now, the taking the difference between the profit factors of cash-in-advance and LC delivers:

$$\pi^{CIA} - \pi^{LC} = \frac{\tilde{\lambda}}{1+\rho^*+L} - \frac{1}{(1+\rho+L)[1+f^{LC}(1+\rho^*+L)]} \tag{F.15}$$

Taking the derivative with respect to L gives:

$$\frac{\partial(\pi^{CIA} - \pi^{LC})}{\partial L} = -\frac{\tilde{\lambda}}{(1+\rho^*+L)^2} + \frac{1+f^{LC}(2+\rho+\rho^*+2L)}{[(1+\rho+L)[1+f^{LC}(1+\rho^*+L)]]^2} \tag{F.16}$$

Plugging the interest rates back in yields:

$$\frac{\partial(\pi^{CIA} - \pi^{LC})}{\partial L} = -\frac{\tilde{\lambda}}{(1+r^*)^2} + \frac{1+f^{LC}[(1+r)+(1+r^*)]}{[(1+r)[1+f^{LC}(1+r^*)]]^2} \tag{F.17}$$

Which is strictly larger than 0 iff:

$$\tilde{\lambda} < \left(\frac{1+r^*}{1+r}\right)^2 \frac{1+f^{LC}[(1+r)+(1+r^*)]}{[1+f^{LC}(1+r^*]^2} \tag{F.18}$$

The difference between the profit factors of open account and LC is:

$$\pi^{OA} - \pi^{LC} = \frac{\tilde{\lambda}^*}{1+\rho+L} - \frac{1}{(1+\rho+L)[1+f^{LC}(1+\rho^*+L)]} \tag{F.19}$$

Taking the derivative with respect to L gives:

$$\frac{\partial(\pi^{OA}-\pi^{LC})}{\partial L}=-\frac{\tilde{\lambda}^*}{(1+\rho+L)^2}+\frac{1+f^{LC}[(1+\rho+L)+(1+\rho^*+L)]}{[(1+\rho+L)[1+f^{LC}(1+\rho^*+L)]]^2} \tag{F.20}$$

Plugging the interest rates back in leads to:

$$\frac{\partial(\pi^{OA}-\pi^{LC})}{\partial L}=-\frac{\tilde{\lambda^*}}{(1+r)^2}+\frac{1+f^{LC}[(1+r)+(1+r^*)]}{[(1+r)[1+f^{LC}(1+r^*)]]^2} \tag{F.21}$$

Which is strictly larger than 0 iff:

$$\tilde{\lambda}^*<\frac{1+f^{LC}[(1+r)+(1+r^*)]}{[1+f^{LC}(1+r^*]^2} \tag{F.22}$$

■

Proof of proposition 3 **Proof.** We begin by deriving a useful corollary.

Corollary 1 *Suppose $\alpha<\frac{1}{1+r^*}$. Then, expected profits from cash-in-advance, open account and LC change in the destination country payment probability $\tilde{\lambda}^*$ in the following way:*

$$\frac{\partial\Pi^{OA}}{\partial\tilde{\lambda}^*}>\frac{\partial\Pi^{LC}}{\partial\tilde{\lambda}^*}>\frac{\partial\Pi^{CIA}}{\partial\tilde{\lambda}^*}=0 \tag{F.23}$$

It is easy to see that $\frac{\partial\pi^{CIA}}{\partial\tilde{\lambda}^*}=0$ and that $\frac{\partial\pi^{LC}}{\partial\tilde{\lambda}^*}>0$ and $\frac{\partial\pi^{OA}}{\partial\tilde{\lambda}^*}>0$. It therefore remains to be shown that $\frac{\partial\Pi^{OA}}{\partial\tilde{\lambda}^*}>\frac{\partial\Pi^{LC}}{\partial\tilde{\lambda}^*}$. Begin by taking the difference of the profit factors of open account and LC:

$$\pi^{OA}-\pi^{LC}=\frac{\tilde{\lambda}^*}{1+r}-\frac{1}{(1+r)[1+(m+\alpha(1-\tilde{\lambda}^*))(1+r^*)]} \tag{F.24}$$

Taking the derivative with respect to $\tilde{\lambda}^*$ gives:

$$\frac{\partial\pi^{OA}-\pi^{LC}}{\partial\tilde{\lambda}^*}=\frac{1}{1+r}-\frac{(1+r^*)\alpha}{(1+r)[1+(m+\alpha(1-\tilde{\lambda}^*))(1+r^*)]^2} \tag{F.25}$$

The derivative is larger than zero if:

$$\alpha<\frac{(1+f(1+r^*))^2}{1+r^*} \tag{F.26}$$

As $f\leq 0$, a sufficient condition for this is:

$$\alpha<\frac{1}{1+r^*} \tag{F.27}$$

The corollary states that as long as banks are sufficiently efficient in reducing risk through LCs (small α), the profitability of contracts changes with an increase in the destination country payment probability $\tilde{\lambda}^*$ in the following way: profits from open account increase the most, profits from LC increase by less and profits from cash-in-advance remain unaffected. We can now prove the main result of Proposition 3. $\alpha < \frac{1}{1+r^*}$ implies the ordering of first derivatives as described in corollary **??**. If each payment contract is used for some $\tilde{\lambda}^*$, the slopes imply the following order: cash-in-advance for $\forall \tilde{\lambda}^* \leq \bar{\lambda}_1^*$. Open account for $\forall \tilde{\lambda}^* \geq \bar{\lambda}_2^* > \bar{\lambda}_1^*$. LC for $\forall \tilde{\lambda}^* \in (\bar{\lambda}_1^*, \bar{\lambda}_2^*)$. ■

References

Ahn, JaeBin, "A Theory of Domestic and International Trade Finance," IMF Working Papers 11/262, International Monetary Fund November 2011.

_ , "Estimating the Direct Impact of Bank Liquidity Shocks on the Real Economy: Evidence from Letter-of-Credit Import Transactions in Colombia," 2013. mimeo.

Amiti, Mary and David E. Weinstein, "Exports and Financial Shocks," *The Quarterly Journal of Economics*, 2011, *126* (4), 1841–1877.

Anderson, James E. and Eric van Wincoop, "Trade Costs," *Journal of Economic Literature*, September 2004, *42* (3), 691–751.

Antràs, Pol and C. Fritz Foley, "Poultry in Motion: A Study of International Trade Finance Practices," NBER Working Papers 17091, National Bureau of Economic Research, Inc May 2011.

Asmundson, Irena, Thomas William Dorsey, Armine Khachatryan, Ioana Niculcea, and Mika Saito, "Trade and trade finance in the 2008-09 financial crisis," Technical Report 2011.

Beck, Thorsten, "Financial Development and International Trade: Is there a Link?," *Journal of International Economics*, June 2002, *57* (1), 107–131.

_ , "Financial Dependence and International Trade," *Review of International Economics*, May 2003, *11* (2), 296–316.

_ **, Asli Demirguc-Kunt, and Ross Levine**, "Financial institutions and markets across countries and over time - data and analysis," Policy Research Working Paper Series 4943, The World Bank May 2009.

Berman, Nicolas, Jos de Sousa, Philippe Martin, and Thierry Mayer, "Time to ship during financial crises," CEPR Discussion Papers 9089, C.E.P.R. August 2012.

Bourgeon, Pauline, Jean-Charles Bricongne, and Guillaume Gaulier, "Do Financial Frictions and Trading Time matter for trade? Evidence from French firms," 2012. mimeo.

Chor, Davin and Kalina Manova, "Off the cliff and back? Credit conditions and international trade during the global financial crisis," *Journal of International Economics*, 2012, *87* (1), 117 – 133.

Djankov, Simeon, Caroline Freund, and Cong S Pham, "Trading on Time," *The Review of Economics and Statistics*, May 2010, *92* (1), 166–173.

Eaton, Jonathan and Samuel Kortum, "Technology, Geography, and Trade," *Econometrica*, September 2002, *70* (5), 1741–1779.

Eck, Katharina, Martina Engemann, and Monika Schnitzer, "How Trade Credits Foster International Trade," Working Papers 116, Bavarian Graduate Program in Economics (BGPE) March 2012.

Felici, Roberto and Marcello Pagnini, "Distance, Bank Heterogeneity and Entry in Local Banking Markets," *The Journal of Industrial Economics*, 2008, *56* (3), 500–534.

Glady, Nicolas and Jacques Potin, "Bank Intermediation and Default Risk in International Trade-Theory and Evidence," 2011. ESSEC Business School, mimeo.

Hale, Galina, Christopher Candelaria, Julian Caballero, and Sergey Borisov, "Bank Linkages and International Trade," Technical Report, Federal Reserve Bank of San Francisco 2013.

Hoefele, Andreas, Tim Schmidt-Eisenlohr, and Zhihong Yu, "Payment Choice in International Trade: Theory and Evidence from Cross-country Firm Level Data," Working Paper 556, F.R.E.I.T. October 2012.

Hummels, David L. and Georg Schaur, "Time as a Trade Barrier," *American Economic Review*, December 2013, *103* (7), 2935–59.

ICC, "Rethinking Trade Finance 2009: An ICC Global Survey," ICC Banking Commission Market Intelligence Report, International Chamber of Commerce 2009.

_ , "Global Risks - Trade Finance Report 2013," Technical Report, International Chamber of Commerce April 2013.

IFC, "Global Trade Finance Program Brochure," Technical Report, International Finance Corporation January 2012.

IMF, "Survey Among Banks Assessing Current Trade Finance Environment," IMF-BAFT Trade Finance Survey, International Monetary Fund 2009.

Levchenko, Andrei A., "Institutional Quality and International Trade," *Review of Economic Studies*, July 2007, *74* (3), 791–819.

Manova, Kalina, "Credit constraints, heterogeneous firms, and international trade," *The Review of Economic Studies*, 2013, *80* (2), 711–744.

Mayer, Thierry and Soledad Zignago, "Market Access in Global and Regional Trade," Working Papers 2005-02, CEPII research center January 2005.

Niepmann, Friederike, "Banking across borders with heterogeneous banks," Staff Report 609, Federal Reserve Bank of New York 2013.

_ **and Tim Schmidt-Eisenlohr**, "No Guarantees, No Trade: How Banks Affect Export Patterns," Staff Report 659, Federal Reserve Bank of New York 2013.

Nunn, Nathan, "Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade," *The Quarterly Journal of Economics*, May 2007, *122* (2), 569–600.

Olsen, Morten, "How Firms Overcome Weak International Contract Enforcement: Repeated Interaction, Collective Punishment and Trade Finance," 2013. mimeo.

Paravisini, Daniel, Veronica Rappoport, Philipp Schnabl, and Daniel Wolfenzon, "Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit-Export Data," Working Paper 16975, National Bureau of Economic Research April 2011.

Prete, Silvia Del and Stefano Federico, "Trade and finance: is there more than just trade finance? Evidence from matched bank-firm data," 2012. mimeo.

Rauch, James E, "Networks versus markets in international trade," *Journal of international Economics*, 1999, *48* (1), 7–35.

Rhee, Changyong and E. Young Song, "Trade Finance and Trade Collapse during the Global Financial Crisis: Evidence from the Republic of Korea," Februart 2013. Mimeo.

Schmidt-Eisenlohr, Tim, "Towards a theory of trade finance," *Journal of International Economics*, 2013, *91* (1), 96 – 112.

Yeaple, Stephen R., "Firm heterogeneity and the structure of U.S. multinational activity," *Journal of International Economics*, July 2009, *78* (2), 206–215.

Table 1: The effect of global risk and funding costs on trade finance, 1998-2011

	(1)	(2)	(3)	(4)
$\log(\text{imp}_t)$	-0.365	-0.872***	-0.0599	0.136
	(0.231)	(0.320)	(0.271)	(0.255)
$\log(\text{exp}_t)$	2.200***	2.245***	1.987***	1.859***
	(0.173)	(0.278)	(0.213)	(0.203)
$\log(\text{U.S. GDP}_t)$	-1.877***	-0.549	-1.996***	-2.334***
	(0.376)	(0.394)	(0.316)	(0.321)
$\log(\text{VIX}_t)$		0.184**	0.139***	0.0530
		(0.0824)	(0.0450)	(0.0427)
$\log(\text{Libor}_t)$	-0.163***		-0.158***	
	(0.0200)		(0.0161)	
$\log(\text{Fed Funds Rate}_t)$				-0.143***
				(0.0137)
Observations	56	56	56	56
R-squared	0.913	0.808	0.925	0.934

Note: This table analyzes the relationship between global risk, global financing costs and aggregate trade finance claims. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks over all countries in a given quarter. Global risk is proxied by the VIX index. Global financing costs are proxied by the Libor and the Fed Funds Rate. All regressions include a constant. Robust standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table 2: The effect of time to trade on bank trade finance

	OLS		IV			
	(1)	(2)	(3)	(4)	(5)	(6)
			first	second	first	second
$\log(\text{population}_{ct})$			0.937***		0.936***	
			(0.0446)		(0.0458)	
$\log(\text{exp}_{ct})$	1.036***	1.108***		1.112***		1.248***
	(0.0453)	(0.0570)		(0.0623)		(0.0769)
$\log(\text{distance}_{c})$	0.415*	0.830***	-1.065***	0.466**	-1.086***	0.920***
	(0.218)	(0.223)	(0.187)	(0.222)	(0.167)	(0.235)
$\log(\text{time to import}_{ct})$		0.584**			-0.670***	0.697***
		(0.235)			(0.199)	(0.246)
$\log(\text{GDPpc}_{ct})$	-0.314***	-0.138	0.955***	-0.372***	0.730***	-0.209*
	(0.0677)	(0.103)	(0.0553)	(0.0802)	(0.0738)	(0.109)
Observations	1,627	664	1,627	1,627	664	664
R-squared	0.676	0.682	0.799	0.673	0.806	0.673

Note: This table analyzes the relationship between time to trade and country-level trade finance claims. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by year and destination country. Time to trade is proxied by distance from the U.S. and by the time to import from the World Bank Doing Business Indicators. Columns (1) and (2) report results from OLS regressions. Columns (3)-(6) report results from IV regressions. The log of population in the destination country instruments the log of exports. All regressions include time-fixed effects. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table 3: The effect of country risk on bank trade finance, EIU risk measure, OLS

	(1)	(2)	(3)	(4)	(5)	(6)
$\log(\text{exp}_{ct})$	1.019***	1.022***	1.022***	1.132***	0.647***	0.641***
	(0.0683)	(0.0683)	(0.0696)	(0.0729)	(0.177)	(0.181)
$\log(\text{distance}_{c})$	0.103	0.184	0.181	0.547**		
	(0.268)	(0.265)	(0.263)	(0.270)		
$\log(\text{time to import}_{ct})$				0.865***		
				(0.247)		
$\log(\text{GDPpc}_{ct})$	-0.408***	-0.327**	-0.368	-0.324*	0.891***	1.651
	(0.152)	(0.162)	(1.055)	(0.164)	(0.300)	(1.075)
$\log(\text{GDPpc}^2_{ct})$			0.00251			-0.0484
			(0.0659)			(0.0646)
risk_{ct}	-0.0117	0.118**	0.119**	0.117*	0.0816*	0.0746
	(0.0137)	(0.0554)	(0.0589)	(0.0659)	(0.0483)	(0.0493)
risk^2_{ct}		-0.00130**	-0.00131**	-0.00159**	-0.000707	-0.000622
		(0.000518)	(0.000549)	(0.000628)	(0.000490)	(0.000502)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	No	No	Yes	Yes
Observations	910	910	910	461	910	910
R-squared	0.612	0.624	0.624	0.679	0.880	0.880

Note: This table analyzes the relationship between destination country risk and country-level trade finance claims. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by year and destination country. Country risk is proxied by the Economist Intelligence Unit risk index. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table 4: The effect of country risk on bank trade finance, EIU risk measure, IV

	(1) first	(2) second	(3) first	(4) second	(5) first	(6) second
$\log(\text{population}_{ct})$	0.937***		1.066***		1.067***	
	(0.0680)		(0.306)		(0.336)	
$\log(\text{exp}_{ct})$		1.144***		2.877***		2.879***
		(0.0930)		(0.784)		(0.757)
$\log(\text{distance}_{c})$	-1.109***	0.248				
	(0.260)	(0.269)				
$\log(\text{GDPpc}_{ct})$	0.920***	-0.388**	0.557***	-0.260	0.764*	0.0479
	(0.0987)	(0.169)	(0.121)	(0.593)	(0.443)	(1.162)
$\log(\text{GDPpc}^2{}_{ct})$					-0.0132	-0.0198
					(0.0244)	(0.0640)
risk_{ct}	-0.0846	0.122**	-0.0332**	0.175***	-0.0350**	0.173***
	(0.0698)	(0.0550)	(0.0146)	(0.0603)	(0.0143)	(0.0595)
$\text{risk}^2{}_{ct}$	0.000826	-0.00131**	0.000265*	-0.00144**	0.000288*	-0.00141**
	(0.000643)	(0.000517)	(0.000148)	(0.000597)	(0.000149)	(0.000591)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	Yes	Yes	Yes
Observations	910	910	910	910	910	910
R-squared	0.715	0.616	0.981	0.808	0.981	0.808

Note: This table analyzes the relationship between destination country risk and country-level trade finance claims, using IV estimation. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by year and destination country. Country risk is proxied by the Economist Intelligence Unit risk index. The log of population in the destination country instruments the log of exports. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table 5: Heterogeneous responses to changes in the VIX, EIU risk measure

	OLS			IV	
	(1)	(2)	(3)	(4)	(5)
				first	second
$\log(\text{exp}_{ct})$	0.595***	0.595***	0.619***		2.306***
	(0.0917)	(0.0913)	(0.104)		(0.442)
$\log(\text{VIX}_t)$	0.579**	2.516***			
	(0.261)	(0.754)			
$\log(\text{Libor}_t)$	0.00331	0.00191			
	(0.0317)	(0.0315)			
$\log(\text{risk}_{ct})$	0.0740	0.346***	0.337***	-0.0137	0.344***
	(0.0457)	(0.104)	(0.106)	(0.0311)	(0.117)
risk^2_{ct}	-0.000366	-0.00331***	-0.00330***	0.000133	-0.00303**
	(0.000423)	(0.00104)	(0.00105)	(0.000328)	(0.00122)
risk_{ct} * $\log(\text{VIX}_t)$	-0.0120**	-0.101***	-0.0985***	-0.00927	-0.0723*
	(0.00546)	(0.0316)	(0.0320)	(0.0108)	(0.0385)
risk^2_{ct} * $\log(\text{VIX}_t)$		0.000966***	0.000953***	0.0000702	0.000680*
		(0.000318)	(0.000321)	(0.000109)	(0.000396)
$\log(\text{domestic absorption}_{ct})$				0.559***	
				(0.106)	
Time FE	No	No	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	3,707	3,707	3,707	3,450	3,450
R-squared	0.835	0.836	0.839	0.970	0.750

Note: This table analyzes the relationship between global risk, destination country risk and country-level trade finance claims. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by quarter and destination country. Global risk is proxied by the VIX index. Country risk is proxied by the Economist Intelligence Unit risk index. Columns (1) to (3) report results from OLS regressions. Columns (4) and (5) report results from an IV regression. The log of domestic absorption in the destination country instruments the log of exports. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table 6: Heterogeneous responses to changes in the LIBOR, EIU risk measure

	OLS			IV	
	(1)	(2)	(3)	(4)	(5)
				first	second
$\log(\text{exp}_{ct})$	0.613***	0.614***	0.641***		2.359***
	(0.0942)	(0.0931)	(0.105)		(0.454)
$\log(\text{VIX}_t)$	0.00210	0.00679			
	(0.0564)	(0.0568)			
$\log(\text{Libor}_t)$	-0.359***	-1.024**			
	(0.128)	(0.391)			
$\log(\text{risk}_{ct})$	0.0337	0.0119	0.0118	-0.0337**	0.0873*
	(0.0439)	(0.0449)	(0.0470)	(0.0161)	(0.0501)
risk^2_{ct}	-0.000373	-0.000155	-0.000172	0.000268*	-0.000633
	(0.000411)	(0.000427)	(0.000437)	(0.000155)	(0.000482)
$\text{risk}_{ct} * \log(\text{Libor}_t)$	0.00776***	0.0378**	0.0377**	-0.00448	0.0457**
	(0.00271)	(0.0174)	(0.0177)	(0.00622)	(0.0178)
$\text{risk}^2_{ct} * \log(\text{Libor}_t)$		-0.000320*	-0.000325*	0.0000405	-0.000389**
		(0.000185)	(0.000187)	(0.0000685)	(0.000194)
$\log(\text{domestic absorption}_{ct})$				0.556***	
				(0.106)	
Time Fe	No	No	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Observations	3,707	3,707	3,707	3,450	3,450
R-squared	0.837	0.837	0.840	0.970	0.748

Note: This table analyzes the relationship between global financing costs, destination country risk and country-level trade finance claims. The dependent variable is the log of the sum of the trade finance claims of all U.S. banks by quarter and destination country. Global financing costs are proxied by the Libor. Country risk is proxied by the Economist Intelligence Unit risk index. Columns (1) to (3) report results from OLS regressions. Columns (4) and (5) report results from an IV regression. The log of domestic absorption in the destination country instruments the log of exports. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Table 7: Trade finance intensity as dependent variable

	(1) annl	(2) annl	(3) annl	(4) qtrl	(5) qtrl	(6) qtrl	(7) qtrl
log(distance$_c$)	0.760***	0.172					
	(0.213)	(0.264)					
log(time to import$_{ct}$)	0.497**						
	(0.227)						
log(GDPpc$_{ct}$)	-0.0818	-0.316**	0.709**	0.920***	0.929***	0.949***	0.952***
	(0.0985)	(0.158)	(0.294)	(0.233)	(0.234)	(0.229)	(0.233)
[1em] risk$_{ct}$		0.117**	0.0965**	0.107**	0.342***	0.0638	0.0386
		(0.0555)	(0.0476)	(0.0440)	(0.113)	(0.0419)	(0.0459)
risk$^2_{ct}$		-0.00130**	-0.000823*	-0.000436	-0.00299**	-0.000466	-0.000217
		(0.000518)	(0.000488)	(0.000443)	(0.00115)	(0.000409)	(0.000457)
risk$_{ct}$*log(VIX$_t$)				-0.0139**	-0.0911**		
				(0.00589)	(0.0349)		
risk$^2_{ct}$*log(VIX$_t$)					0.000835**		
					(0.000357)		
risk$_{ct}$*log(Libor$_t$)						0.00800***	0.0394**
						(0.00275)	(0.0166)
risk$^2_{ct}$*log(Libor$_t$)							-0.000333*
							(0.000176)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	No	No	Yes	Yes	Yes	Yes	Yes
Observations	664	910	910	3,429	3,429	3,429	3,429
R-squared	0.180	0.136	0.720	0.683	0.685	0.686	0.688

Note: This table reports robustness checks for all main specifications of the paper with trade finance intensity as dependent variable. The dependent variable is trade finance intensity, the ratio of trade finance claims over U.S. exports by destination country. Columns (1) to (3) use annual data. Columns (4) to (7) use quarterly data. Time to trade is proxied by distance to the U.S. and by the time to import from the World Bank Doing Business Indicators. Country risk is proxied by the Economist Intelligence Unit risk index. Global risk is proxied by the VIX. Global financing costs are proxied by the Libor. Standard errors are clustered at the country level and are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level.

Figure 1: How a letter of credit works

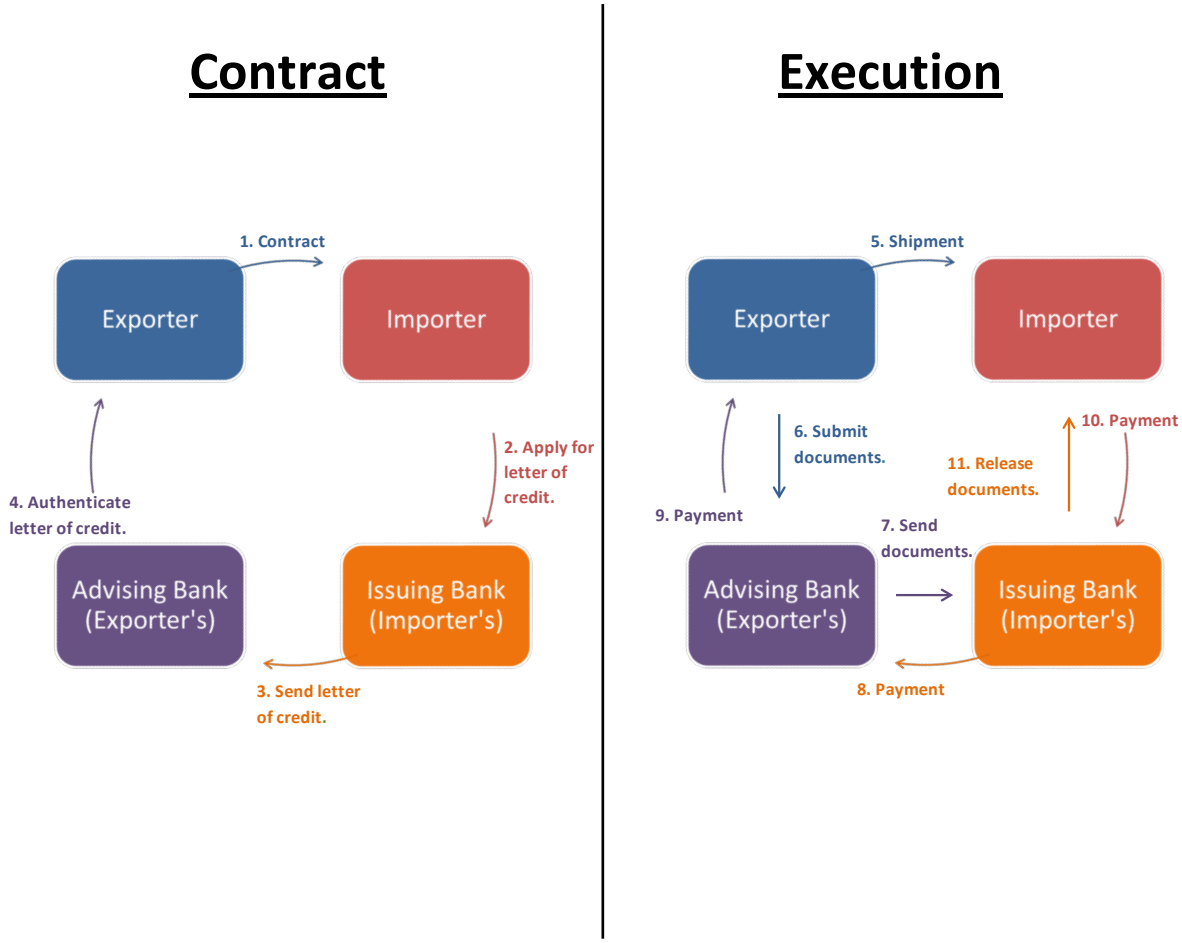
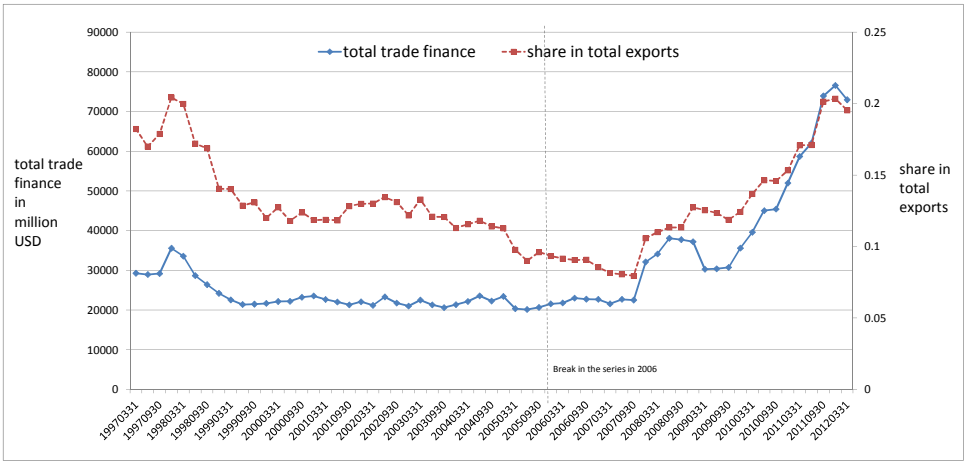
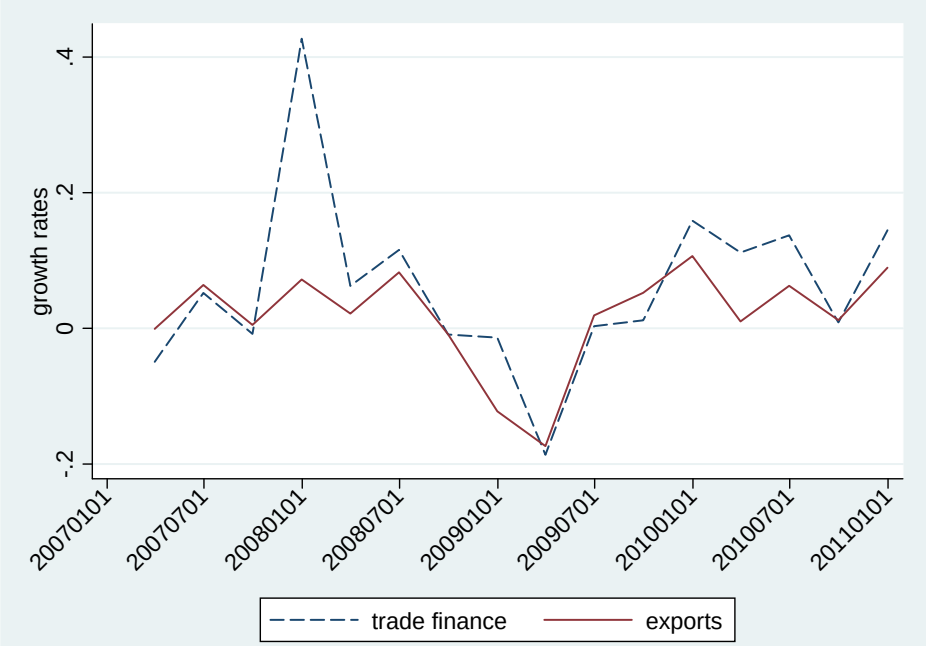


Figure 2: Evolution of trade finance over time



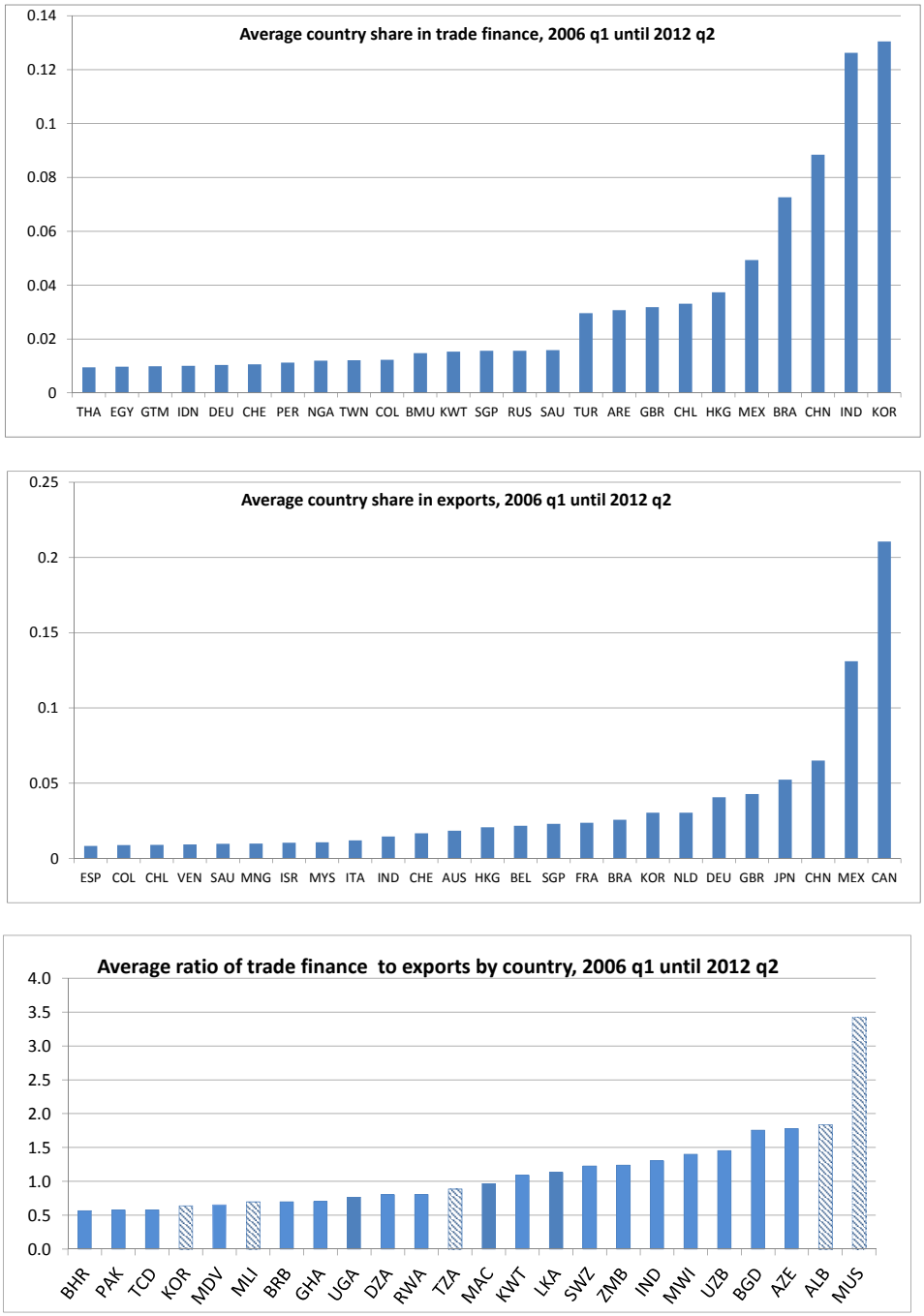
Note: The solid line in the graph shows the evolution of total trade finance claims from 1997 to 2012 (left y-axis). The dashed line corresponds to the share of total trade finance claims in total U.S. exports in goods (right y-axis). Data sources: FFIEC 009 Report, IMF Directions of Trade Statistics.

Figure 3: Trade finance and export growth during the crisis



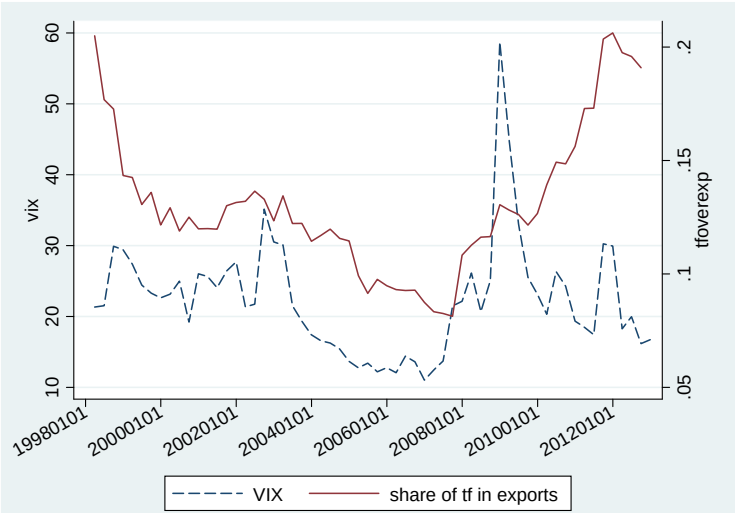
Note: The dashed line in the graph shows the quarterly growth rates of U.S. trade finance claims over the period from 2007 until 2010. The solid line displays the corresponding growth rates of U.S. exports in goods. Data sources: FFIEC 009 Report, IMF Directions of Trade Statistics.

Figure 4: Top countries in terms of trade finance, exports and trade finance intensity



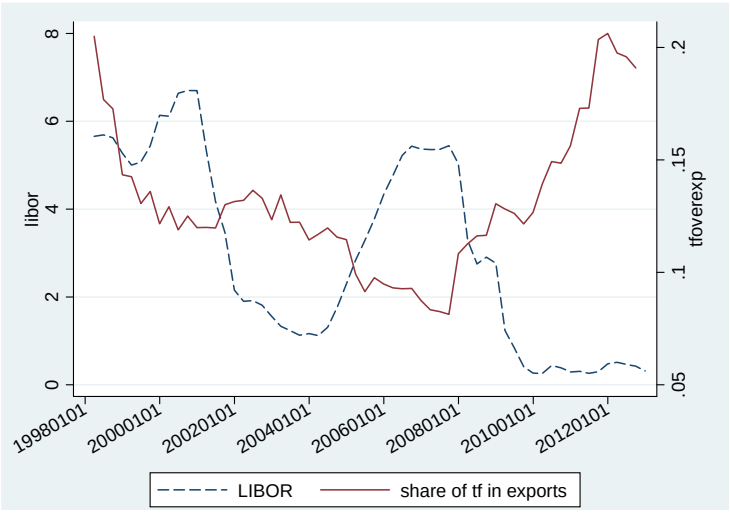
Note: The upper panel shows the top countries in terms of their shares in total trade finance claims averaged over the period from 2006 to 2012. The panel in the middle indicates the top export destinations measured by their average export shares. In the lower panel, those countries are displayed that have the highest average trade finance intensity. Bars with patterns indicate offshore financial centers. Data sources: FFIEC 009 report, IMF Directions of Trade Statistics.

Figure 5: Co-movement of trade finance intensity and the Volatility Index



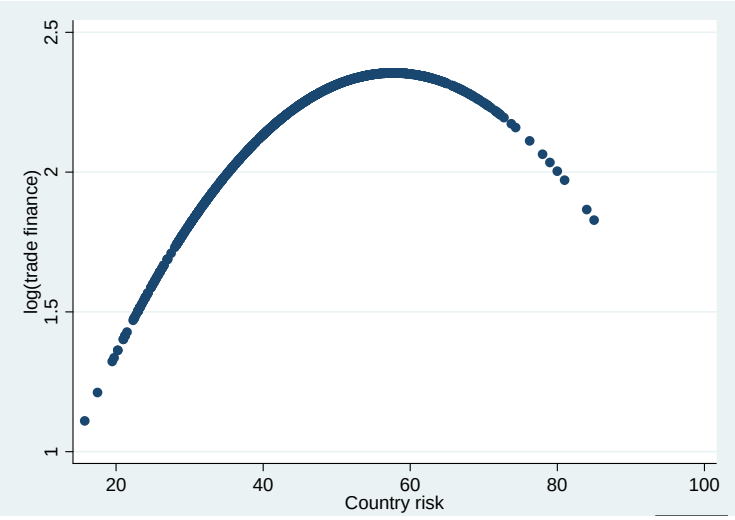
Note: The graph shows the ratio of U.S. trade finance claims to U.S. exports in goods for the period from 1997 to 2012 together with quarterly averages of the CBOE Volatility Index, which measures the expected volatility of the U.S. stock market over the next 30 days. Data sources: FFIEC 009 report, Bloomberg.

Figure 6: Co-movement of trade finance intensity and Libor



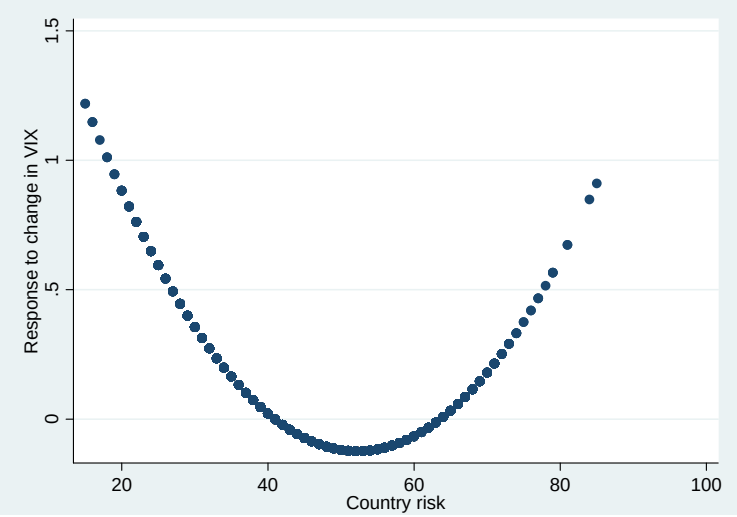
Note: The graph shows the ratio of U.S. trade finance claims to U.S. exports in goods for the period from 1997 to 2012 together with quarterly averages of the 3-month Libor. Data sources: FFIEC 009 report, FRED Economic Data.

Figure 7: The relationship between bank trade finance and country risk



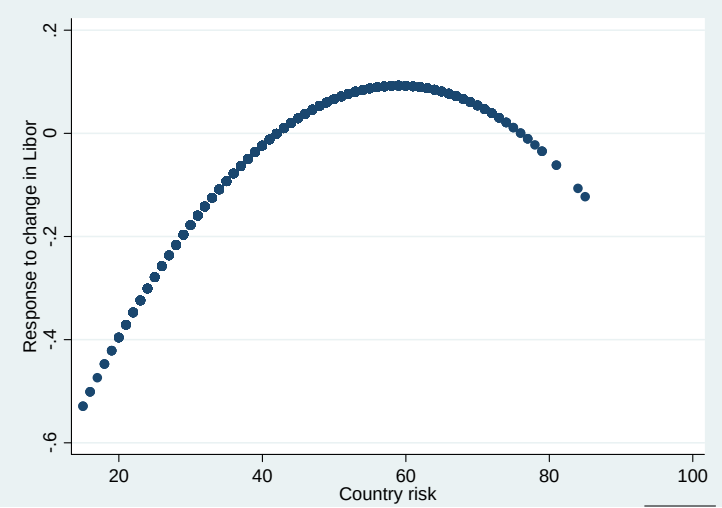
Note: The graph shows the estimated relationship between destination country credit risk and the log of banks' trade finance claims based on the estimates in column (4) of table 3.

Figure 8: Estimated heterogeneous response to changes in the VIX



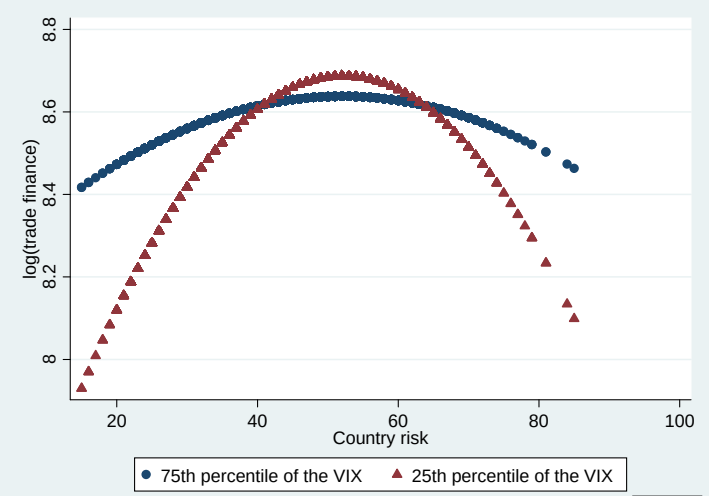
Note: The graph displays the estimated change of banks' trade finance claims as a function of credit risk when the VIX index changes by 1 percent. Calculations are based on the estimates in column (3) of table 5.

Figure 9: Estimated heterogeneous response to changes in Libor



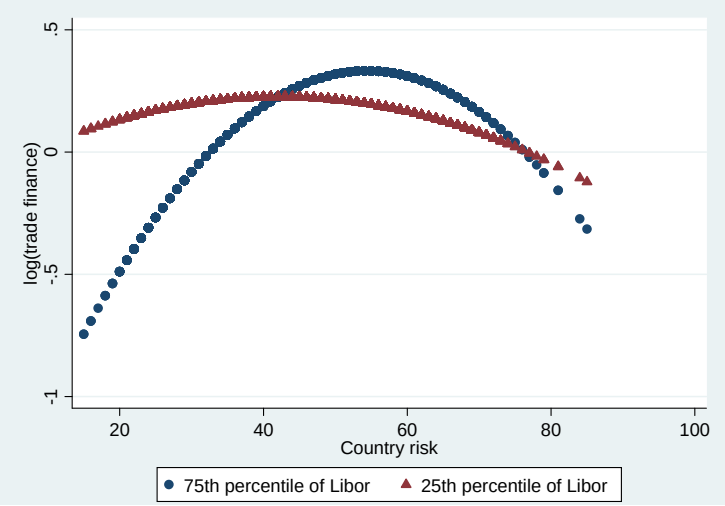
Note: The graph displays the estimated change of banks' trade finance claims as a function of credit risk when the Libor changes by 1 percent. Calculations are based on the estimates in column (2) of table 6.

Figure 10: Relationship between trade finance and country risk for different levels of the VIX



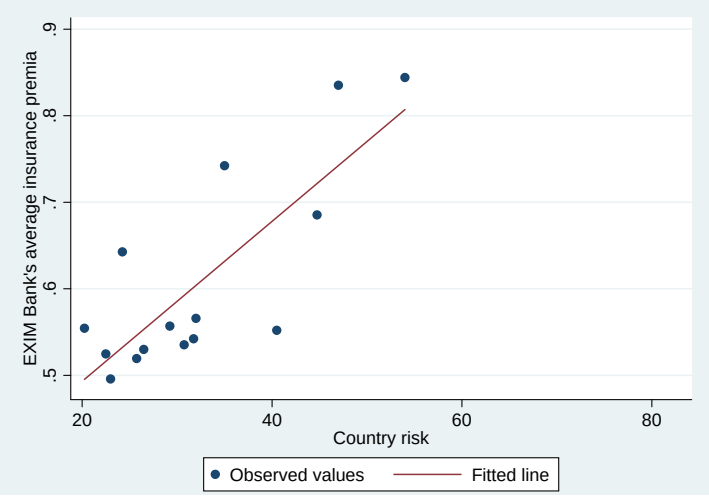
Note: The graph shows the estimated relationship between destination country credit risk and the log of banks' trade finance claims for high (75 percentile) and low (25 percentile) levels of the VIX.

Figure 11: Relationship between trade finance and country risk for different levels of the Libor



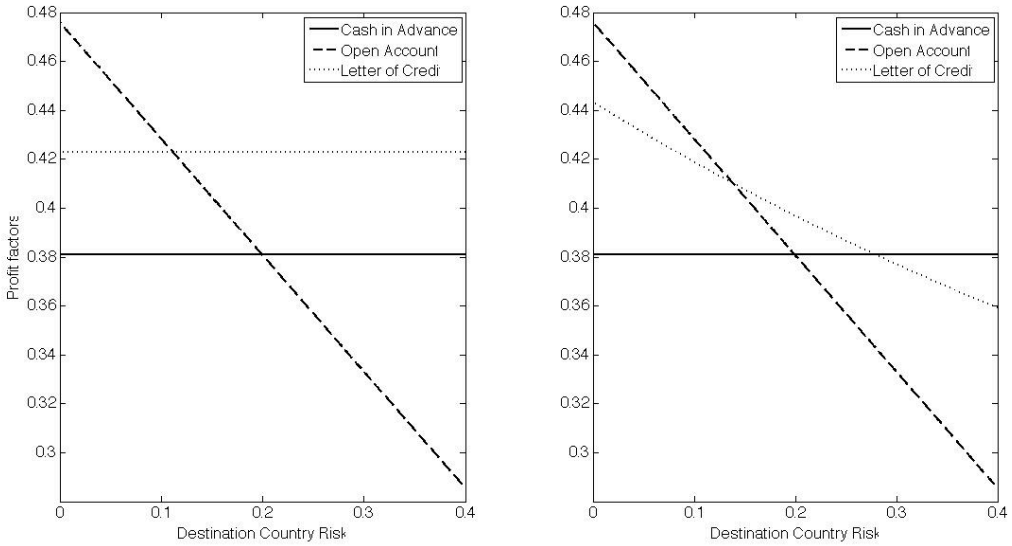
Note: The graph shows the estimated relationship between destination country risk and the log of banks' trade finance claims for high (75 percentile) and low (25 percentile) levels of the Libor.

Figure 12: A country's insurance premium increases in country-level risk



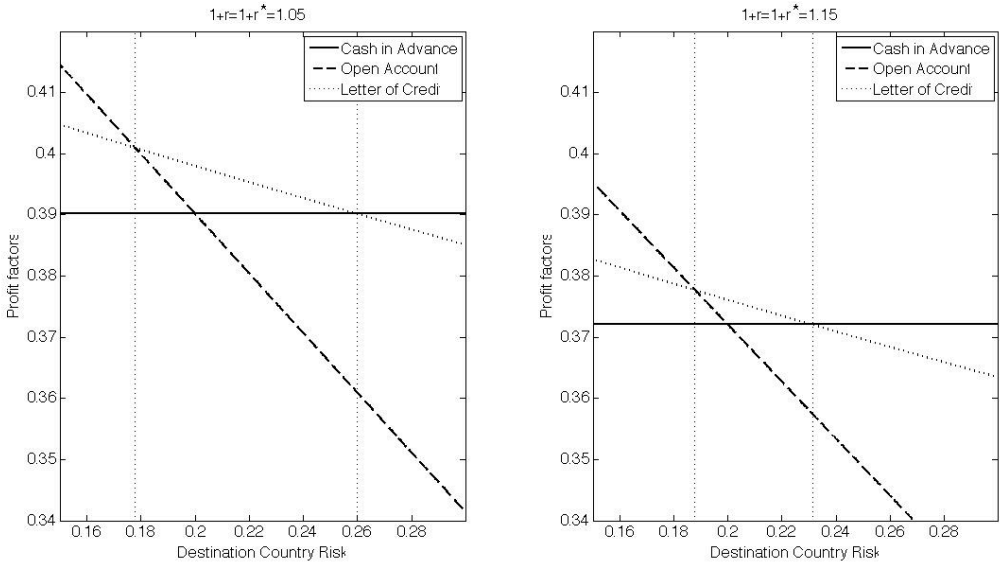
Note: The graph shows the average insurance premium charged by the U.S. Export-Import Bank for export transactions in the year 2004 plotted again country risk measured by the EUI risk index.

Figure 13: Profitability of letters of credit as a function of risk



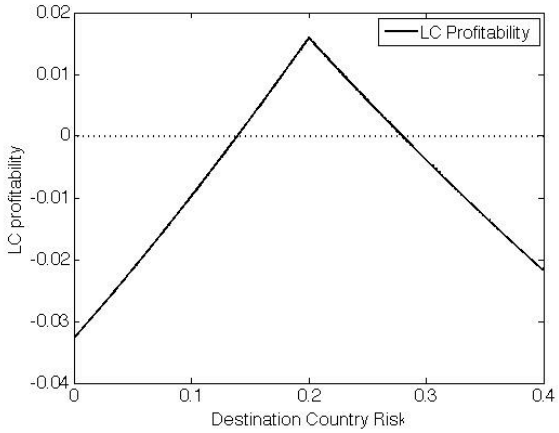
Note: Both panels of the graph plot the exporter's profit factors under the three payment forms (cash-in-advance, open account, and letter of credit) as a function of the importer's default risk λ^*. The left graph depicts the case of a fixed letter-of-credit fee in which letter-of-credit profits are independent of destination country risk. The right graph shows the profit factors in the case of an endogenous letter of credit fee. Then, letter-of-credit profits decrease in destination country risk.

Figure 14: The effect of an increase in aggregate financing costs



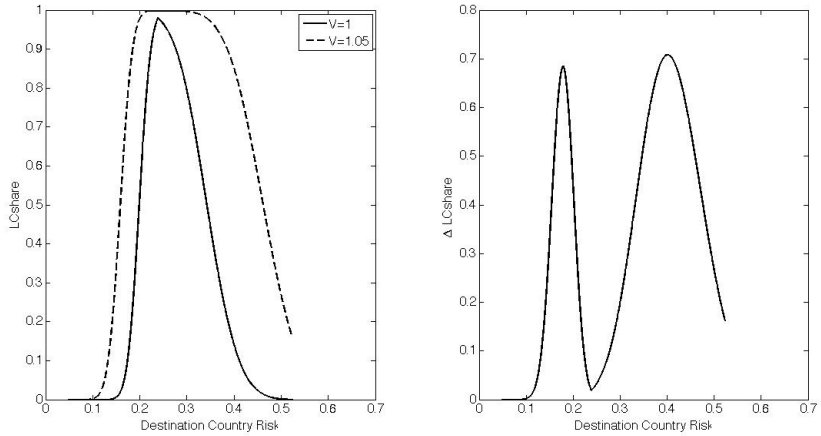
Note: Both panels of the graph plot the exporter's profit factors under the three payment forms (cash-in-advance, open account, and letter of credit) as a function of the importer's default risk λ^*. The left graph depicts profit factors when global financing costs are low. The right graph shows the profit factors after a symmetric increase of the financing costs in the source and the destination country, keeping all other parameters fixed. This reduces profits under all payment forms, the most for letters of credit. The vertical lines show that the range of risk levels for which letters of credits dominate decreases.

Figure 15: Non-linear relationship between letter-of-credit use and destination country risk



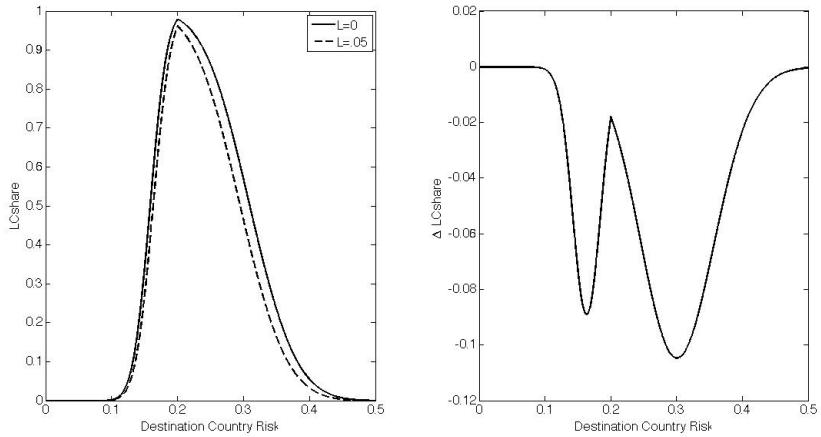
Note: The graph displays the relative profitability of a letter of credit as a function of the importer's default risk. It corresponds to the difference between profits when a letter of credit is used and the profits of the most preferred alternative payment method. At the peak, the exporter is indifferent between open account and cash-in-advance. In the region where the line is above zero, the exporter prefers to arrange the payment through a letter of credit.

Figure 16: Heterogeneous response to changes in VIX in the model



Note: The figure is based on the following model parameters: $m = .06, \quad \alpha = .2, \quad \tilde{\lambda} = .8, \quad r = r^* = .05 \quad \tilde{\lambda}^* \in [0.5, 1]$. The left graph shows the share of firms that choose letters of credit for different levels of country risk. The solid line assumes an aggregate uncertainty factor V of 1. The dotted line results when the uncertainty factor is increased to $V = 1.05$. The right graph shows the change in the use of letters of that is associated with the increase in risk, i.e. the difference between the two lines in the first graph. The response to an increase in the Vix is u-shaped in country risk.

Figure 17: Heterogeneous response to changes in Libor in the model



Note: The figure is based on the following model parameters: $m = .06, \quad \alpha = .2, \quad \tilde{\lambda} = .8, \quad r = r^* = .05 \quad \tilde{\lambda}^* \in [0.5, 1]$. The left graph shows the share of firms that choose letters of credit for different levels of country risk. The solid line assumes an aggregate interest spread L of 0. The dotted line results when the spread is increased to $L = 0.05$. The right graph shows the change in the use of letters of credit that is associated with the increase in risk, i.e. the difference between the two lines in the first graph. The response to an increase in ρ is hump-shaped in country risk.