

# No Guarantees, No Trade: How Banks Affect Export Patterns\*

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**Abstract**

How relevant are financial instruments to manage risk in international trade for exporting? Employing a unique dataset of U.S. banks' trade finance claims by country, this paper estimates the effect of shocks to the supply of letters of credit on U.S. exports. Our identification strategy relies on two observations. First, banks vary in their importance as providers of letters of credit across countries. Second, a reduction in the supply of letters of credit by a bank should have a larger effect on exports to those destinations where the bank takes a larger share of the trade finance market. We show that a one-standard deviation negative shock to a country's supply of letters of credit reduces U.S. exports by 1.5 percentage points. This effect is stronger for smaller and poorer destinations. It more than doubles during crisis times, suggesting a non-negligible role for finance in explaining the Great Trade Collapse.

*Keywords:* trade finance, global banks, letter of credit, exports, financial shocks

*JEL-Codes:* F21, F23, F34, G21

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# 1 Introduction

This paper exploits a unique dataset available at the Federal Reserve to shed new light on the link between finance and international trade. It explores the role of letters of credit, a financial instrument to reduce risk in international trade, for exporting. It shows that reductions in the supply of letters of credit by banks have causal effects on U.S. exports, thereby identifying a new channel through which financial shocks are transmitted to the real economy and across borders.<sup>1</sup> The effects on exports are asymmetric across destination markets and across time; letter of credit supply shocks have stronger effects for smaller and poorer destination countries, where fewer U.S. banks are active, and reduce exports twice as much during crisis times than during tranquil times.<sup>2</sup> Because of the high concentration of the trade finance business, a reduction in the supply of trade guarantees by a single big bank affects the level and patterns of aggregate U.S. exports.

These findings suggest a central role for client-bank relationships, implying that firms cannot switch easily between banks to obtain trade financing, and lend support to the idea of granularity coined by Gabaix (2011).<sup>3</sup> They also indicate a non-negligible role for trade finance in the Global Recession and, specifically, the Great Trade Collapse.<sup>4</sup> Worsening financial conditions may have a greater effect on international trade than on domestic sales because international transactions take longer so that firms require more working capital (working capital channel). At the same time, international trade is riskier, and firms use specific financial instruments, such as letters of credit (LCs), to

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<sup>1</sup>Recent papers on the real effects of financial shocks include Peek and Rosengren (1997), Peek and Rosengren (2000), Ashcraft (2005), Khwaja and Mian (2008), Mian and Sufi (2010) and Chodorow-Reich (2014). For a seminal paper on the Great Depression see Bernanke (1983). For papers on the role of global banks in international spillover effects, see, e.g., Bruno and Shin (forthcoming), Cetorelli and Goldberg (2012), Kalemli-Ozcan et al. (2013), and Ongena et al. (2013).

<sup>2</sup>This aspect is closely linked to literature on financial development and trade patterns. Beck (2003) and Manova (2013) show that differences in financial development can generate comparative advantage, confirming a theoretical point first made by Kletzer and Bardhan (1987).

<sup>3</sup>Sharpe (1990) and Williamson (1987), for example, provide theoretical models to explain why firms might not obtain financing from another bank when their home bank does not provide credit. Empirical evidence for the stickiness of firm-bank relationships is also provided in Chodorow-Reich (2014), Greenstone and Mas (2012) and Jimenez et al. (2012), for example.

<sup>4</sup>While, for example, Amiti and Weinstein (2011), Chor and Manova (2012) and Paravisini et al. (forthcoming) see a role for financial factors in explaining the collapse in trade during the recent financial crisis, Eaton et al. (2011), Bems et al. (2010), and Levchenko et al. (2010) argue that most of the drop can be explained by changes in demand and compositional effects.

reduce the risk of exporting (risk channel). We identify this risk channel, showing that if firms cannot obtain bank guarantees, they trade less. In carrying out this analysis, we present several methodological innovations building on the approach proposed by Greenstone and Mas (2012) and Amiti and Weinstein (2013) to structurally estimate supply shocks.<sup>5</sup>

Information on trade finance employed in this paper is from the FFIEC 009 Country Exposure Report that all large U.S. banks are required to file.<sup>6</sup> We observe banks' trade finance claims, which reflect mostly LCs in support of U.S. exports, by destination country at a quarterly frequency over a period of 15 years. The total trade finance claims of all reporting banks account for roughly 20 percent of U.S. exports in 2012. Thus, the trade finance activities captured in the report are sizable relative to trade.

Based on these data, we estimate time-varying trade finance supply shocks. To isolate idiosyncratic supply shocks from demand shocks, trade finance growth rates at time  $t$  in country  $c$  are regressed on bank-time fixed effects  $\alpha_{bt}$  as well as on country-time fixed effects  $\beta_{ct}$ . The estimated bank-time fixed effects  $\alpha_{bt}$  correspond to idiosyncratic bank-level supply shocks. To address potential endogeneity concerns, we estimate bank-time fixed effects separately for each country, always dropping country  $i$  information from the sample to obtain the bank shocks that we use for country  $i$ . We show that bank shocks are positively correlated with growth in loans and negatively correlated with banks' credit default swap spreads. This is evidence that the estimated bank-time fixed effects capture idiosyncrasies in banks' business conditions. However, the methodology also allows the bank-time fixed effects to pick up strategic decisions by bank managers to expand or contract the trade finance business.

Changes in the supply of LCs can have an effect on trade because exporters and importers cannot easily switch between different banks when they want to settle a transaction based on this instrument. An LC is a means to reduce the risk of a trade, which works as follows: The importer asks a bank in her country to issue an LC. This letter

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<sup>5</sup>We propose a normalization to make bank shocks comparable across time, obtain bank shocks separately for each country, systematically dropping information on similar countries to counter endogeneity concerns, and demonstrate how sorting into markets can be addressed. We discuss the details of our innovations after introducing the methodology.

<sup>6</sup>These data were first used in Niepmann and Schmidt-Eisenlohr (2013).

is sent to the exporter. It guarantees that the issuing bank will pay the agreed contract value to the exporter if a set of conditions is fulfilled.<sup>7</sup> In addition, a bank in the exporter's country typically confirms the LC, whereby the confirming bank commits to paying if the issuing bank defaults. Because banks need to work with correspondent banks abroad, the provision of LCs implies significant fixed costs for banks so that the business is highly concentrated with only a few large players. Also, banks learn about the credit- and trustworthiness of their clients over time, and such information is not easily transferable. These factors should make it hard for a firm to switch to another bank when its home bank does not provide the service. When firms are not willing to trade without an LC or adjust quantities because expected profits from trading under alternative payment forms are lower, a reduction in the provision of LCs by a single bank has an effect on exports.

The identification strategy pursued in this paper exploits the variation in the importance of banks as providers of LCs across countries. The same reduction in the supply of LCs by a bank should have a bigger effect in markets where the bank has a larger share of the trade finance business. Accordingly, the shock to bank  $b$  at time  $t$  is weighted by the market share of bank  $b$  in country  $i$  at time  $t - 2$ , and these weighted shocks are summed over all banks in the sample. The resulting country-time specific shocks are used to predict exports.

The baseline specification tests whether country-level trade finance supply shocks explain the variation in export growth rates controlling for a common time effect and a country-specific trend in the export growth rate. We find statistically and economically significant effects. A country-level shock of one standard deviation decreases exports, on average, by 1.5 percentage points. We show that below median shocks have larger effects than above median shocks in line with Amiti and Weinstein (2011), which indicates that our identification comes mostly from reductions in the supply of trade finance and not from increases.

The identifying assumption that establishes a causal link between supply shocks and exports is that there are no time-varying unobserved country-specific factors that

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<sup>7</sup>For example, the issuing bank may promise to pay upon receipt of shipping documents.

are correlated with both export growth and supply shocks. Given our methodology, two conditions need to hold. First, the estimated shock to the supply of LCs by bank  $b$ , based on information from countries other than country  $i$ , is not correlated with changes in the demand for trade finance and, hence, growth in exports to country  $i$ . Second, banks with positive shocks to their supply of trade finance in period  $t$  do not sort, at time  $t - 2$ , into markets with positive deviations from trend export growth in period  $t$ . These conditions would be violated if banks were specialized in specific industries or if banks sorted into markets based on future export growth. We demonstrate that the possibility that banks specialize is not supported by the data and does not drive our results. In addition, bank-level shocks are negatively serially correlated and results are unchanged when different lags of banks' market shares are used. These findings together rule out the systematic sorting of banks into markets and strongly suggest that the link found in this paper is indeed causal.

In a quantitative exercise, we evaluate the effect of a negative shock to the trade finance supply of one large bank. A reduction that corresponds to the 10th percentile of the bank-level shock distribution leads to a 1.4-percentage-point decline in total U.S. exports growth. This illustrates that the behavior of a single bank can have a considerable effect in the aggregate due to the high concentration of the business.

Another key result of this paper is that banks can affect export patterns. Because banks specialize in confirming and issuing LCs in certain markets, a reduction in the supply of LCs by a single bank has asymmetric effects across destination countries. We show that a shock of the same size to two different banks affects exports to different regions of the world differentially, depending on the markets in which each bank specializes. Hence, the patterns of banks' global activities determine to which markets shocks are transmitted.

In addition, we find that the effect of LC supply shocks are heterogeneous across export destinations. Exports to smaller and poorer destinations where fewer U.S. banks are active decline more when banks reduce their supply of trade finance. We also present evidence that the effect of reductions in the supply of trade finance are stronger during times of financial distress. In a crisis period, the effect more than doubles compared

to normal times. These findings can be explained as follows. Firms use LCs more intensively and are less willing to trade without them when exporting to riskier markets and when economic uncertainty is high. At the same time, it is more difficult for firms to switch to other banks. There are fewer banks active in smaller markets. Moreover, banks may be less willing to expand to new markets and less able to obtain liquidity or to take on more risk during a financial crisis. Together the presented results suggest that the LC channel is quantitatively relevant and that a lack of trade finance can constrain exports especially to the smaller and poorer countries.

Paravisini et al. (forthcoming), who study the working capital channel, do not find evidence that bank shocks affect exports differentially across destinations. This highlights that the distinction between the working capital channel and the LC channel matters. A reduction in the supply of bank guarantees should have a different effect on trade than a reduction in the supply of general loans. First, working capital needs are independent of payment risk, whereas the risk that the importer defaults determines whether an exporter demands an LC. Moreover, working capital loans are fungible and firms can internally reallocate available funds. LCs, in contrast, are destination specific and can only be obtained from a small number of banks.

**Literature on Finance and Trade** Only a few papers study the role of financial shocks in international trade. Using Japanese matched bank-firm data from 1990 to 2010, Amiti and Weinstein (2011) show that if a bank has a negative shock to its market-to-book value, a firm that lists this bank as its main bank has a drop in exports that is larger than the observed drop in domestic sales. While the authors establish a general link between banks and trade, they cannot test for the heterogeneous effects of shocks across export destinations and cannot directly distinguish between different transmission channels due to data limitations.<sup>8</sup>

Paravisini et al. (forthcoming) study the working capital channel using matched bank-firm data from Peru. The authors find that credit supply shocks reduced exports during the recent financial crisis. As discussed above, the effects do not differ across

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<sup>8</sup>Indirect evidence for the risk channel is provided: exports of firms that have affiliates drop less than exports of stand-alone firms.

export destinations.

Del Prete and Federico (2014) employ Italian matched bank-firm data that allow them to distinguish between general loans, trade-related loans and guarantees. They report that trade is affected by changes in the supply of general loans but not by changes in the supply of trade-specific loans and guarantees. As this paper shows, the size of a destination country and other characteristics are of first-order importance for the risk channel. The fact that the authors cannot estimate the effect of trade finance supply shocks by destination country most likely explains why they do not find that the supply of bank guarantees matters for trade.

Three other papers also focus on the risk channel. Ahn (2013) analyzes the effect of bank balance-sheet shocks on the provision of LCs in 2008/2009 in Colombia. Similar to the results in this paper, he finds that bank balance-sheet items predict the variation in bank-level LC supply. He does not test for the effect of supply shocks on aggregate trade flows, however. Van der Veer (forthcoming) studies the role of trade credit insurance and finds a relationship between the supply of insurance by one large insurer and aggregate trade flows. Auboin and Engemann (2014) exploit data on export insurance from the Berne Union to analyze the effect of insurance on trade. Hale et al. (2013) document that an increase in bank linkages between countries is associated with larger bilateral exports, conjecturing that banks mitigate export risk.

The paper is structured as follows. Sections 2 and 3 give background information on banks' role in trade finance and the data, respectively. Section 4 discusses the empirical strategy. Section 5 presents the results and robustness checks. Section 6 quantifies the aggregate effects of LC supply shocks. Section 7 concludes.

## **2 A Primer on Trade Finance and Letters of Credit**

### **2.1 The role of banks in facilitating trade**

When exporters and importers engage in a trade, they have to agree on who finances the transaction and who bears the risk. Banks help both with financing and with mitigating

the risk. First, consider the financing decision. If the exporter produces first and the importer pays after receiving the goods, the exporter pre-finances the transaction, which is referred to as open account. Alternatively, if the importer pays before receiving the goods, trade is done on cash-in-advance terms, and the importer provides the working capital to the exporter. In both cases, a firm can either use funds out of its cash flows or ask for a loan from a bank to finance the working capital or the pre-payment.

Second, any transaction entails a risk that one of the trading partners will not comply. Under open account, the importer may not pay after receiving the goods. Under cash-in-advance, the exporter may not deliver the goods after receiving the payment. To address these commitment problems, banks offer LCs. Figure 1 illustrates how they work. A bank in the importing country issues an LC, which is sent to the exporter. The LC guarantees that the issuing bank will pay 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. In most cases, a bank in the exporting country is also involved in the LC transaction. Because there is still a risk that the issuing bank will default on its obligation, the exporter can ask a bank in her country to confirm the LC. The confirming bank thereby agrees to pay the exporter if the issuing bank defaults. To the extent that banks can monitor the transaction, the commitment problems that arise under open account and cash-in-advance are resolved with an LC, since the exporter is paid only after delivering the goods and the importer commits to paying by making her bank issue an LC.<sup>9</sup>

Both the financing costs and the risk of international transactions are higher than those of domestic sales. Working capital needs are typically higher because transaction times are longer due to customs procedures and a greater distance between the seller and the buyer. Evidence in favor of this hypothesis is presented in Schmidt-Eisenlohr

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<sup>9</sup>An LC roughly corresponds to settling a payment on open account with a bank guarantee. It is similar to open account in that the exporter still needs to pre-finance the transaction and gets paid only after confirmation of delivery. It differs in that the risk the exporter has to bear is reduced by the guarantee of the bank. Moreover, the importer has to pay a fee to her bank in advance and the requested guarantee might reduce her available credit lines. The financial costs of an LC are therefore higher. See Schmidt-Eisenlohr (2013), Antràs and Foley (forthcoming) and Hoefele et al. (2013) for a more detailed discussion of the three payment forms.

(2013), for example, who finds that changes in interest rates affect trade more between countries that are farther away from each other.

More importantly for this paper, international trade is riskier than domestic sales because contracts are harder to enforce across borders. In addition, less information about the reliability of trading partners may be available. Accordingly, LCs are widely used in international trade and are employed to a much smaller extent for domestic sales. Data from the SWIFT Institute on LCs show this. In 2012, around 92 percent of all LCs in support of U.S. sales were related to exports and only 8 percent to domestic activity.<sup>10</sup>

## **2.2 Market structure of the business**

The trade finance business and, in particular, the market for bank guarantees is highly concentrated. Niepmann and Schmidt-Eisenlohr (2013) and Del Prete and Federico (2014) present details on the market structure for the U.S. and Italy, respectively. In 2012, the top 5 banks accounted for 92 percent of all trade finance claims in the U.S. In Italy, the business is similarly concentrated. Only ten Italian banks extend trade guarantees.

The high concentration is likely due to high fixed costs. When U.S. banks confirm an LC, they need to work with banks abroad and have knowledge of their credit- and trustworthiness. U.S. banks also have to do background checks on their customers to comply with due diligence requirements and anti-money laundering rules before they can engage in any business abroad. They also need to be familiar with the foreign market and the legal environment there. Such knowledge is costly to acquire and not easily transferable.

Due to the presence of information asymmetries, the importance of relationships, and the resulting high concentration of the market, it should be difficult for a firm to switch to another bank when its home bank refuses to confirm or issue an LC. Anecdotal evidence suggests that banks provide trade financing only to their core customers, since

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<sup>10</sup>These calculations are based on quarterly information about the number of SWIFT MT700 messages that were received by U.S. banks.

the profit margins on LCs and similar instruments are small.

Note that there is no alternative method that reduces commitment problems to the same degree. Trade credit insurance, another option for exporters, does not reduce the risk but instead shifts it to another agent, the insurer.<sup>11</sup> As a consequence, the price of insurance should increase more with destination country risk than the price of LCs, and insurance may be unavailable in the most risky destinations. If an LC cannot be obtained and trade insurance is very costly or cannot be bought, importers and exporters may not be willing to trade. Then a reduction in the supply of LCs has an effect on trade.<sup>12</sup>

### 2.3 Public provision of trade finance

Most multinational development banks today run large trade finance programs, with the view that the private sector may not meet the demand. These programs were small at first and often targeted to the least developed countries. However, they were expanded substantially during the 2008/2009 crisis and now also cover many emerging economies.<sup>13</sup> The Global Trade Finance Program of the International Finance Organization, which is a part of the World Bank group, for example, now has a \$5 billion program that mostly confirms letters of credit through participating private banks.<sup>14</sup>

Surveys of banks conducted by the International Monetary Fund and the International Chamber of Commerce support the view that the supply of trade finance can constrain international trade. Asmundson et al. (2011) report that 38 percent of large

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<sup>11</sup>When issuing or confirming an LC, banks actively screen documents and manage the conditional payment to the exporter and thereby resolve the commitment problem. Trade credit insurance also implies a guarantee of payment but has no direct effect on the underlying commitment problem. This difference can best be seen in a model with risk-neutral firms as in Schmidt-Eisenlohr (2013). There, firms demand LCs but have no reason to buy trade credit insurance.

<sup>12</sup>Note that there is an effect on trade even if an alternative contract is chosen by a firm. It follows from revealed preferences that whenever LCs are used, other payment forms generate weakly lower profits. Hence, a reduction in the supply of LCs can affect both the intensive and the extensive margins of trade. Quantities decline as trade finance costs, which represent variable trade costs, go up. If costs become sufficiently large, trade becomes unprofitable.

<sup>13</sup>In 2009, in the wake of the great recession, the G20 agreed on a \$250 billion program over two years to support trade finance. See G20 (2009).

<sup>14</sup>See IFC (2012) for more details.

banks said in July 2009 that they were not able to satisfy all their customer needs and 67 percent were not confident that they would be able to meet further increases in trade finance demand in that year. Greater trade finance constraints may also come from increases in prices. According to the same survey, letter of credit prices increased by 28 basis points (bps) over the cost of funds from 2007 q4 to 2008 q4 and by another 23 bps over the cost of funds between 2008 q4 and 2009 q2.<sup>15</sup> Banks also reported that their trade-related lending guidelines changed. Every large bank that tightened its guidelines said that it became more cautious with certain countries. Thus, constraints may differ by destination country. As we will show in the next sections, this survey evidence is consistent with the results presented in this paper.

### 3 Data Description

The data on trade finance used in this paper are from the Country Exposure Report (FFIEC 009). U.S. banks and U.S. subsidiaries of foreign banks that have more than \$30 million in total foreign assets are required to file this report and have to provide, country by country, information on their trade-finance-related claims with maturity of one year and under. Claims are reported quarterly on a consolidated basis; that is, they also include the loans and guarantees extended by the foreign affiliates of U.S. banks. The sample covers the period from the first quarter of 1997 to the second quarter of 2012.<sup>16</sup>

The statistics are designed to measure the foreign exposures of banks. This information allows regulators to evaluate how U.S. banks would be affected by defaults and crises in foreign countries. Therefore, only information on the claims that U.S. banks

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<sup>15</sup>Similar results are obtained in the ICC survey. 42 percent of respondents in a 2009 survey report that they increased their prices for commercial letters of credit issuance, whereas 51 percent left prices unchanged and 7 percent decreased them. LC confirmation also got more expensive. 58 percent of respondents report that they increased their prices, while only 2 percent lowered their fees.

<sup>16</sup>Until 2005, banks' trade finance claims are reported on an immediate borrower basis; that is, a claim is attributed to the country where the contracting counter-party resides. From 2006 onward, claims are given based on the location of the ultimate guarantor of the claim (ultimate borrower basis). This reporting change does not appear to affect the value of banks' trade finance claims in a systematic way, so we use the entire time series without explicitly accounting for the change. See <http://www.ffiec.gov/> for more details.

have on foreign parties is collected. Loans to U.S. residents and guarantees that back the obligations of U.S. parties are not recorded. While we can rule out based on the reporting instructions that letters of credit in support of U.S. imports or pre-export loans to U.S. exporters are included, it is conceivable that several trade finance instruments that support either U.S. exports, U.S. imports, or third-party trade constitute the data.<sup>17</sup> Niepmann and Schmidt-Eisenlohr (2013) provide a detailed discussion and exploration of the data and we provide a summary of the findings here. Their analysis indicates first, that banks' trade finance claims reflect trade finance in support of U.S. exports, and second, that the main instrument in the data are letters of credit.

Before presenting in detail evidence for these two conjectures, we explain the link between the reported claims and export values. Suppose that a U.S. bank confirms a letter of credit issued by a bank in Brazil. Then the U.S. bank would suffer a loss in the event that the Brazilian bank defaults on its obligation to pay. Accordingly, the U.S. bank reports claims vis-à-vis Brazil equivalent to the value of the letter of credit. The value of the letter of credit, in turn, is determined by the value of the goods that the Brazilian firm buys from the U.S. exporter. So there is a direct link between claims and the value of the exported goods. Similarly, if an affiliate of a U.S. bank in Brazil issues a letter of credit to a Brazilian importer, the affiliate backs the obligations of the foreign importer. Accordingly, the parent bank, which files the Country Exposure Report on a consolidated basis –meaning that the claims *of* its affiliate appear on its balance sheet but not the claims *on* its affiliate, reports the contract value as claims vis-à-vis Brazil. Since the average maturity of a confirmed letter of credit is 70 days (see ICC (2013)), the stock of claims at the end of a quarter is highly correlated with the flow of exports in that quarter; thus, we compare quarterly stocks with quarterly trade flows. The data on U.S. trade in goods used in this paper are from the IMF Direction of Trade Statistics.

We now turn to the evidence that the FFIEC 009 data largely reflect letters of credit in support of U.S. exports. Consider columns (1) to (3) of table 2, which present the results of OLS regressions, in which the log of banks' total trade finance claims in quarter  $t$  in country  $c$  is regressed on the log of imports from country  $c$ , the log of exports to

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<sup>17</sup>Table 1 summarizes which instruments could be included based on the reporting instructions.

country  $c$  and total non-U.S. imports and exports of country  $c$  at time  $t$ . The second column includes time fixed effects. The third column has both time and country fixed effects. Standard errors are clustered at the destination country level. The estimated coefficients show that banks' trade finance claims are primarily driven by U.S. exports. While the point estimates associated with U.S. imports, non-U.S. imports and non-U.S. exports are small and insignificant, the coefficient of U.S. exports is large and significant at a 1 percent significance level throughout. The coefficient in column (1) suggests that if U.S. exports rise by 10 percent, banks' trade finance claims increase by 8.6 percent.

A comparison with data from the SWIFT Institute suggests that the main instrument in the FFIEC009 data are letters of credit. SWIFT provides a communications platform to exchange standardized financial messages, which is used by the vast majority of banks in the world. When a letter of credit transaction occurs, the issuing bank in the importer's country sends a SWIFT MT700 message to the confirming bank in the exporter's country, specifying the terms of the letter of credit and the parties involved. The SWIFT Institute provided us with the number of monthly MT700 messages received by banks located in the U.S. from 2002 to 2012 by sending country. To the extent that banks' trade finance claims reflect letters of credit, there should be a close link between the quarterly value of bank claims and the number of SWIFT messages sent within a quarter. Columns (4) to (6) of table 2 show correlations between the two variables. The number of SWIFT messages received by U.S. banks is a strong predictor of banks' trade finance claims controlling for U.S. exports as well as time and country fixed effects.<sup>18</sup> A rise in the number of SWIFT messages by 10 percent increase banks' trade finance claims by 6 percent according to column (4) of table 2. We also have information on the value of the letters of credit received by U.S. banks from the fourth quarter of 2010 onward. In that quarter, the total value of SWIFT messages accounts for 67 percent of banks' total trade finance claims, which indicates again that the claims data mostly captures LCs.

In addition to the arguments made above, Niepmann and Schmidt-Eisenlohr (2013)

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<sup>18</sup>Note that Niepmann and Schmidt-Eisenlohr (2013) also include LC messages sent by U.S. banks to country  $i$  in the regressions, which reflect LCs issued to U.S. firms that import from origin  $i$ . This variable has zero explanatory power. LCs in support of U.S. imports are not in the data.

show that the claims data behaves in many respects like the MT700 messages. For example, the use of letters of credit by U.S. exporters is expected to be hump-shaped in destination country risk and the authors find that this relationship holds for both banks' trade finance claims and SWIFT MT700 messages. Thus everything points to letters of credit being the single most important instrument in the data. If bank claims captured other trade finance instruments to a substantial degree, the analysis in this paper would still be valid. The only other instrument in support of U.S. exports that can be included in the data are pre-import loans to foreign firms.<sup>19</sup> To the extent that this is the case, the estimated shocks would not necessarily only reflect shocks to the supply of letters of credit but also to credit provided by U.S. banks to foreign importers.

Figure 2 depicts the evolution of U.S. exports and banks' trade finance claims over time, as shown in Niepmann and Schmidt-Eisenlohr (2013). Trade finance claims peaked in 1997/1998 during the Asian crisis and again during the financial crisis in 2007-2009.<sup>20</sup> Since 2010, claims have increased considerably, which is likely due to the low interest rate environment and the retrenchment of European banks from this U.S.-dollar-denominated business, allowing U.S. banks to gain their market shares. The graph clearly indicates that trade finance plays an important role for U.S. firms. In 2012, total trade finance claims of U.S. banks amounted to roughly 20 percent of U.S. exports.

Figure 3 shows the distribution of trade finance claims and U.S. exports across world regions in the second quarter of 2012. Regions are ranked in descending order from the left to the right according to their shares in total trade finance. The upper bar displays the trade finance shares of the different regions. The lower bar illustrates regions' shares in U.S. exports. While around 50 percent of U.S. exports go to high income OECD countries, banks' trade finance claims in these countries only account for around 20 percent. In contrast, East Asia and the Pacific only receive 11 percent of U.S. exports, but this region's share in trade finance is twice as large. The figure indicates substantial

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<sup>19</sup>Credit to U.S. firms cannot be in the data given the reporting instructions. Forfeiting and factoring, which also reduce the risk of a transaction for the exporter, could be included but statisticians at the New York Fed tell us that this is not likely to be the case since U.S. banks are not very active in this business.

<sup>20</sup>Evidence from Italy and IMF surveys also suggests that trade finance expanded during the recent financial crisis. See Del Prete and Federico (2014) and Asmundson et al. (2011).

variation in the extent to which exporters rely on trade guarantees across regions and destination countries, which could lead to asymmetric effects of reductions in the supply of letters of credit. We explore asymmetries in more detail in section 5.

## 4 Empirical Approach

### 4.1 Estimating trade finance supply shocks

In this section, we discuss the empirical strategy to identify the causal effect of letter-of-credit supply shocks on exports. The challenge in establishing a causal link is to obtain a measure of supply shocks that is exogenous to the demand for LCs. Because we have information on the trade finance claims of U.S. banks by destination country that varies over time, we can estimate time-varying idiosyncratic bank-level supply shocks from the data.<sup>21</sup> In line with Greenstone and Mas (2012) and Amiti and Weinstein (2013), we estimate the following equation:<sup>22</sup>

$$\Delta t f_{bct} = \frac{t f_{bct} - t f_{bct-1}}{t f_{bct-1}} = \alpha_{bt} + \beta_{ct} + \epsilon_{bct}, \quad (1)$$

where  $t f_{bct}$  corresponds to the trade finance claims of bank  $b$  in country  $c$  and quarter  $t$ . Trade finance growth rates are regressed on bank-time fixed effects  $\alpha_{bt}$  and on country-time fixed effects  $\beta_{ct}$ . If all  $\beta_{ct}$ 's were included in the regression together with all  $\alpha_{bt}$ 's, the  $\alpha_{bt}$ 's and  $\beta_{ct}$ 's would be collinear so one fixed effect must be dropped from the regression in each quarter. Without an additional step, the estimated bank-time fixed effect would vary depending on which fixed effect serves as the base category in each period and is omitted from the regression. To avoid this, we regress the estimated bank-time fixed effects on time fixed effects and work with the residuals  $\hat{\alpha}_{bt}$  in place of the estimated  $\alpha_{bt}$ 's. This normalization sets the mean of  $\hat{\alpha}_{bt}$  in each period  $t$  to zero and thereby makes

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<sup>21</sup>Previous works on the effect of finance on trade use proxy variables to identify shocks. Amiti and Weinstein (2011) use banks' market-to-book values. Paravisini et al. (forthcoming), Del Prete and Federico (2014) and Ahn (2013) exploit the variation in banks' funding exposures.

<sup>22</sup>Based on a cross-section observed at two points in time, Greenstone and Mas (2012) estimate a model in log differences to obtain bank shocks. Amiti and Weinstein (2013) use a time-series, as we do, but impose adding-up constraints on the shocks.

it irrelevant which fixed effects are left out when equation 1 is estimated.

The obtained bank-time fixed effects  $\hat{\alpha}_{bt}$  correspond to idiosyncratic bank shocks. By construction, they are independent of country-time specific factors related to the demand for trade finance (and, hence, export growth) that affect all banks in the sample in the same way. To further address the concern that bank shocks might pick up demand effects, bank shocks are estimated for each country separately: the bank shock  $\hat{\alpha}_{ibt}$  for country  $i$  is obtained by estimating equation 1 without including observations of country  $i$ . Therefore,  $\hat{\alpha}_{ibt}$  reflects growth in trade finance claims by bank  $b$  in quarter  $t$  based on changes in claims in all countries except country  $i$ .<sup>23</sup>

The normalized bank-level supply shocks  $\hat{\alpha}_{ibt}$  are used to construct country-specific supply shocks as follows:

$$\text{shock}_{it} = \sum_b^B \phi_{ibt-2} \hat{\alpha}_{ibt}, \quad (2)$$

where  $\phi_{ibt-2} = \frac{tf_{ibt-2}}{\sum_b^B tf_{ibt-2}}$ . Thus, bank supply shocks are weighted by the share of bank  $b$  in the total trade finance claims of country  $i$  at time  $t - 2$  and are summed over all banks in the sample. In section 5.3, we show that results also hold when market shares are lagged by an alternative number of quarters or are averaged over several preceding periods.

The effect of trade finance supply shocks on exports is estimated based on the following equation:

$$\Delta X_{it} = \frac{X_{it} - X_{it-1}}{X_{it-1}} = \gamma \text{shock}_{it} + \delta_t + \delta_i + \eta_{it}, \quad (3)$$

where  $X_{it}$  denotes U.S. exports to country  $i$  at time  $t$ . Export growth rates are regressed on the constructed country-level supply shocks as well as on country fixed effects and time fixed effects. The key coefficient of interest is  $\gamma$ .

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<sup>23</sup>As indicated, it does not matter which fixed effects are dropped in the estimation of equation 1. In practice, we estimate equation 1 for all countries except Canada and exclude Canada fixed effects. In the regression to obtain bank-time fixed effect that apply to Canada, we exclude France fixed effects. While we estimate equation 1 159 times, dropping one country from the sample actually does not matter. Results are essentially identically if we work with bank-time fixed effects obtained from estimating equation 1 only once based on a sample that includes all countries.

Under the assumption that the computed country supply shocks are not systematically correlated with unobserved characteristics that vary at the time-country level and are correlated with exports,  $\gamma$  corresponds to the causal effect of trade finance supply shocks on export growth. Expressed in formulas, the identification assumption is:  $E((\sum_b^B \phi_{ibt-2} \hat{\alpha}_{ibt}) \eta_{it}) = 0$ . Given the presented strategy, the assumption is satisfied if two conditions hold. First, the estimated shock to the supply of LCs by bank  $b$ , based on information from countries other than country  $i$ , is not correlated with changes in the demand for trade finance and, hence, growth in exports to country  $i$ . Second, banks with positive shocks to their supply of trade finance in period  $t$  do not sort, at time  $t - 2$ , into markets with positive deviations from trend export growth in period  $t$ . In section 5.3, we revisit these conditions and provide evidence against the hypothesis that banks specialize in certain industries or sort systematically into export markets.

## 4.2 Description of the sample

U.S. banks have trade finance claims in practically all countries of the world but only a few out of all banks that file the FFIEC009 report have positive values. For example, in the first quarter of 2012, 18 banks had positive trade finance claims in at least one country whereas 51 banks reported none. Three banks had positive trade finance claims in more than 70 countries while seven banks were active in less than five countries. Over the sample period, banks drop in and out of the dataset and acquire other banks. To account for acquisitions, the trade finance growth rates are calculated in the period of an acquisition based on the sum of the trade finance claims of the acquired bank and the acquiring bank in the previous period. The same adjustment is made when the bank shares  $\phi_{ibt-2}$  are calculated. If a bank acquired another bank at time  $t$  or  $t - 1$  we use the country share of the two banks added up to compute bank shares.

Bank supply shocks are estimated on a sample in which observations are dropped for which  $tf_{bct}$  is zero. If  $tf_{bct-1} = 0$ , trade finance growth rates in quarter  $t$  have to be dropped because they go to infinity. To make the estimation less prone to outliers and keep things symmetric, we also drop negative growth rates of 100 percent. For 8.5 percent of all observations  $tf_{bct} = 0$ . The total claims associated with these observations

is small, adding up to a little more than one percent of the value of total claims in the data.<sup>24</sup> We also drop the first and 99th percentiles of the trade finance growth rate distribution based on the remaining observations, further mitigating the influence of outliers. The dataset used to estimate equation 1 and obtain the bank-time fixed effects has 32,256 observations, covers the period from 1997 q2 to 2012 q2 and includes 107 banks as well 159 countries.<sup>25</sup>

### 4.3 Heterogeneity and persistence in banks' market shares

The empirical strategy in this paper requires that the importance of single banks be heterogeneous across destination markets. Otherwise, all countries would be subject to the same shock and we would not be able to identify effects. In addition, it is essential that banks have stable market shares over time, because we use lagged values to compute country shocks. If banks' market shares were very volatile, then lagged values would not contain useful information about the degree to which bank-level supply shocks affect different countries.

The upper panel of table 3 shows summary statistics of  $\phi_{bit}$ , the share of bank  $b$  in the total trade finance claims of all U.S. banks in country  $i$  at time  $t$ , at different points in time. There is substantial heterogeneity at every date. The average bank share increased from 2000 until 2012, consistent with the observed reduction in the number of banks active in the trade finance business.<sup>26</sup> Bank shares range from below 0.1 percent to 100 percent. The standard deviation is 27 percent in the first quarter of 2012.

Persistence in banks' market shares can be reflected in both the intensive and the extensive margin. On the one hand, a bank should account for a stable fraction of a country's overall trade finance supply over time (intensive margin). On the other hand, there should be no frequent exit and entry of banks into markets (extensive margin).

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<sup>24</sup>The share is based on the number of non-missing observations for which it is not the case that claims are zero both in period  $t$  and in period  $t - 1$ .

<sup>25</sup>Given that we always drop one country from the sample to estimate equation 1, the sample is slightly different and smaller in each estimation and includes only 158 countries.

<sup>26</sup>Changes in banks' market shares over time are slow but substantial. Therefore, we cannot use market shares in the beginning of the sample period and keep them constant over time to obtain country-level shocks.

We check whether bank shares are persistent in two different ways. First, we regress the market share  $\phi_{ibt}$  of bank  $b$  in country  $i$  at time  $t$  on country-bank fixed effects. These fixed effects alone explain more than 77 percent of the variation in bank shares, which implies that there is much cross-sectional variation in banks' market shares but little time variation. Second, we regress the current market share  $\phi_{ibt}$  on its lagged values. Without adjusting for mergers and acquisitions, the one-quarter lagged bank share explains around 84 percent of the variation in the current share, as shown in table 4.<sup>27</sup> Two-period lagged values, which are used to construct country supply shocks, still explain around 77 percent of the variation.

A similar exercise can be conducted for the number of banks  $n_{it}$  that are active in a given market  $i$ . The lower panel in table 3 shows statistics for this variable. The number of banks operating in a given country fell over the sample period. In the first quarter of 2012, there were at most 14 banks active in a single country. The mean of the variable is 3.6 and the standard deviation is 2.8 in the same quarter.

A regression of the number of banks in country  $i$  at time  $t$  on country and time fixed effects accounts for more than 76 percent of the variation. As an alternative, similar to before, the number of banks in period  $t$  is regressed on its lagged values. Table 5 displays the results. The two-quarter lagged number of active banks explains approximately 92 percent of the variation in this variable.

We present in table 6 the factors that explain how many U.S. banks serve a destination country since we employ this information again in section 5. Niepmann and Schmidt-Eisenlohr (2013) show that the use of letters of credit increases with the value of exports and a destination's distance to the U.S. Moreover, usage is non-linear in the degree to which contracts can be enforced in the destination so that exports to countries with intermediate contract enforcement rely on letters of credit the most. The different factors not only determine the total volume of bank claims but also the number of banks that are active in a given destination. Size, distance and contract enforcement proxied by a country's rule of law together with GDP per capita explain more than 70 percent of the cross-sectional variation in the number of U.S. banks that are active in a given

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<sup>27</sup>If we adjusted for M&As, then persistence would be even higher.

destination country. This can be seen from columns (1) and (2) of table 6, which are based on cross-sections of two different years. In column (3), regressions are run on pooled cross-sections, which produces very similar results. Thus, the extent to which LCs are used in exports to a country largely determines the number of U.S. banks that have positive trade finance claims in that country.

#### 4.4 Validation of bank supply shocks

There are a total of 107 different banks in the sample for which we obtain trade finance supply shocks. In the third quarter of 1997, bank shocks for 54 different banks are estimated, down to 18 banks in the second quarter of 2012 due to consolidation in the banking sector. In total, we estimate 325,389 time-country-varying bank shocks from 1997 q2 until 2012 q2.<sup>28</sup> Figure 4 shows the distribution of bank shocks, which exhibits significant variation. Table 7 provides the corresponding summary statistics. Figure 5 displays the mean and median normalized bank shock as well as the standard deviation of the bank shocks over time. Note that the mean is by construction equal to zero in each quarter.

To check whether the bank shocks, which are estimated without the use of information on country  $i$ , predict trade finance growth in country  $i$ , we run the following regression:

$$\Delta t f_{ibt} = \hat{\alpha}_{ibt} + \xi_t + \xi_i(+\xi_{it}) + \eta_{ibt}, \quad (4)$$

where  $\Delta t f_{ibt}$  represents the growth rate of the claims of bank  $b$  in country  $i$  in quarter  $t$  observed in the data.  $\hat{\alpha}_{ibt}$  is the normalized bank shock of bank  $b$  at time  $t$  that was estimated based on equation 1 without including  $\Delta t f_{ibt}$  in the sample. The regression results are displayed in table 9. The first column excludes fixed effects; the second column includes both time fixed effects  $\xi_t$  and country fixed effects  $\xi_i$ . The third column controls for country-time fixed effects  $\xi_{it}$ . Standard errors are clustered at the bank-time level. The coefficient on the bank shock is highly significant and positive in all three columns. This shows that the estimated bank shocks based on developments in other

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<sup>28</sup>Recall the bank-time fixed effects are estimated for 159 different countries, so for each estimation of equation 1, we estimate around 2,100 bank-time fixed effects.

countries have strong predictive power for the actual growth of trade finance claims of bank  $b$  in country  $i$  at time  $t$ , although they do not explain much of the variation as the low  $R^2$  in column (1) indicates.

Next, we investigate whether bank supply shocks are serially correlated.<sup>29</sup> Table 10 displays results from a regression of the average bank shock  $\bar{\alpha}_{bt}$ , which corresponds to the value of  $\hat{\alpha}_{ibt}$  averaged over all countries, on its lagged values and time fixed effects. The regression in column (1) includes only the one-quarter lagged bank shock. In column (2), the two-quarter lagged shock is added as a regressor. Column (3) includes one- to four-quarter lagged values of  $\bar{\alpha}_{bt}$ . In all three columns, the coefficients of the one-quarter lagged bank shock is significant and negative. If a bank experiences a contraction (expansion) in its LC supply in one period, it partially offsets it by an expansion (contraction) in the next period. Higher order lags are not significant.

Finally, we check whether bank shocks are correlated with meaningful bank-level variables.<sup>30</sup> To that end, the mean bank shock  $\bar{\alpha}_{bt}$  is regressed on deposit growth, loan growth, growth in real estate charge-offs and the credit default swap spread on senior unsecured debt of bank  $b$  at time  $t$ . Results are displayed in table 8. In columns (1) to (5), time fixed effects are included to control for a common time trend in the growth of banks' balance sheets. In column (6), bank fixed effects are estimated to account for systematic differences in the level of banks' CDS spreads. In all columns, standard errors are clustered at the bank level.

The results in column (1) of table 8 indicate that the average bank shock is larger if banks' deposit growth is higher, although the coefficient is not significant at standard significance levels. Columns (2) and (3) show that the bank shocks are also positively correlated with loan growth and negatively correlated with growth in real estate charge-offs. This is confirmed in columns (4) and (5), in which two or three balance-sheet variables are included simultaneously as regressors. Finally, there is some evidence that the bank shocks are negatively correlated with banks' credit default swap spreads, an

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<sup>29</sup>We use the result of this exercise in section 5.3, in which we discuss our identification strategy and endogeneity concerns in detail.

<sup>30</sup>Balance-sheet information for banks in the sample comes from the Y9c and FFIEC 031 reports. Credit default swap spreads are taken from Markit.com.

implicit measure of banks' funding costs.

The results in table 8 suggest that banks' trade finance claims are related to loan growth and funding conditions. Banks allocate funding to business lines and may cut funding as overall conditions worsen. As trade finance is short term and contracts are liquidated within a few months or even weeks, trade finance can be quickly reduced to shrink banks' overall balance sheet, reduce exposures and improve liquidity. However, banks may also take strategic decisions to grow or contract trade finance for other reasons. Thus, the estimated bank-level shocks may also capture changes in the supply of trade finance that are not closely linked to the current health of the bank. Banks may, for example, decide to contract their operations with foreign entities to refocus on core activities or when due diligence requirements change.<sup>31</sup> There is in fact anecdotal evidence that, due to recently elevated due diligence requirements, some banks have reduced their cooperation with foreign banks. Moreover, European banks withdrew from the international trade finance business after the European sovereign debt crisis, which allowed U.S. banks to grow. The empirical strategy pursued in this paper allows us to capture changes in banks' supply of trade finance for all of these reasons. Therefore, we would not expect that the estimated bank-level shocks can be fully predicted with balance sheet variables.

## 4.5 Distribution of country supply shocks

In a next step, details on the computed country-level supply shocks  $\Delta tf_{it}$  are given. In total, we obtain country shocks for 156 different countries.<sup>32</sup> Table 7 displays the summary statistics for this variable.

The regressions that are run to estimate the effect of trade finance supply shocks on trade include country fixed effects. Therefore, we control for time-invariant country characteristics that are correlated with export growth and trade finance supply shocks. However, results do not change when country fixed effects are left out as we show in the

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<sup>31</sup>See Working Group on Trade, Debt and Finance (2014) for a summary of recent developments in trade finance after the 2007/2008 financial crisis.

<sup>32</sup>The number of countries reduces slightly because lagged bank shares are not observed for all countries for which we can obtain bank-level shocks.

next section. This is because supply shocks are randomly distributed across countries. To illustrate this, figure 6 plots the distribution of the average value of a dummy variable  $d_{it}$  that takes value 1 if the supply shock to country  $i$  in period  $t$  is above the period- $t$  median and zero otherwise. In the limit, where time goes to infinity, random assignment would imply that the mean of the dummy goes to 0.5 for every country. In any finite sample, the dummy should be distributed symmetrically around 0.5. Figure 6 shows that this is the case. A correlation between country-level shocks and country characteristics could only arise if banks with above or below median shocks were associated with particular countries. Figure 6 indicates that this is not the case and, therefore, that there is no correlation between banks' market shares  $\phi_{ibt}$  and the estimated bank-level shocks  $\hat{\alpha}_{ibt}$ .

In the regressions of export growth on country-level supply shocks (equation 3), countries with a population below 250,000, offshore financial centers and observation in the top and bottom one percentile of the export growth rate distribution are excluded from the sample.<sup>33</sup> To control for export demand in the destination country, we add a set of variables. This lowers the number of observations further since these variables are not observed for all countries.<sup>34</sup> However, the properties of the country-level supply shocks are unchanged as the summary statistics for the shock variable of the reduced sample show (see again table 7).

## 5 Results

### 5.1 Baseline Results

Table 11 presents the baseline regression results obtained from estimating equation 3. Unless stated otherwise, standard errors are bootstrapped for all regressions in this section.<sup>35</sup> In column (1), export growth is regressed on trade finance supply shocks and

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<sup>33</sup>A list of countries designated as offshore financial centers can be found in the appendix. Niepmann and Schmidt-Eisenlohr (2013) show that banks' trade finance claims in offshore centers are barely correlated with U.S. exports to these destinations so we drop them since we do not expect a link between trade finance and real activity.

<sup>34</sup>This reduces the number of countries in the baseline sample to 122.

<sup>35</sup>Clustering at the country level essentially delivers the same standard errors.

time fixed effects. The estimated effect of supply shocks is positive and significant at a 1 percent significance level. The positive coefficient indicates that destination countries that experience larger declines in the supply of trade finance exhibit lower export growth rates. In column (2), several independent variables that control for changes in import demand are included in the regression: GDP growth and population growth, the change in the USD exchange rate of the local currency, and growth in non-U.S. imports of country  $i$  in period  $t$ . In column (3), country fixed effects are added. The inclusion of the additional variables and fixed effects does not affect the magnitude of the estimated coefficient of interest  $\gamma$ . This confirms that trade finance supply shocks are not systematically correlated with time-invariant country characteristics as found in the previous section or with demand factors.

A simple quantification highlights that the estimated effect on export growth is large. Based on the coefficient of 0.0888 displayed in column (3), a country supply shock of one standard deviation increases export growth by 1.5 percentage points. This corresponds to about 5 percent of one standard deviation of export growth rates. As a reference, table 7 provides summary statistics of export growth rates in the sample. We discuss the magnitude of the effect in more detail in section 6.

Column (4) of table 11 shows the effect of trade finance supply shocks for above and below median shocks separately.<sup>36</sup> We compute two sets of country-level shocks using either above median or below median bank-level shocks in each period when aggregating shocks up to the country level. The estimated coefficients indicate that above and below median shocks have asymmetric effects. Only the point estimate of shocks below the quarterly median is statistically significant at a 5 percent level. In addition, it is almost three times larger than the coefficient associated with above median shocks.<sup>37</sup> This is in line with what one might expect and confirms findings in Amiti and Weinstein (2011). Because a reduction in the supply of LCs typically requires cutting them for existing customers whereas additional supply is more fungible, shocks below the median should have a stronger effect.

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<sup>36</sup>Because we normalize shocks so that their mean is zero, the absolute level of the shocks is not meaningful. Below median shocks are associated with those banks that contracted more or expanded less than the median bank. The opposite holds for above median shocks.

<sup>37</sup>The estimates are not statistically significantly different from each other, however.

To explore which banks are responsible for the effect on exports, we compute supply shocks for the five biggest trade finance suppliers and the remaining banks separately and rerun the baseline regression.<sup>38</sup> Column (5) of table 11 shows the results. The coefficients on the shocks attributed to the top five banks and the remaining banks are both significant and very similar. It may be surprising that small banks can have an effect in the aggregate. However, smaller banks specialize in certain markets so that they can be large and important for the provision of letters of credit in particular destinations. In column (6), the regression with separate shocks for the top five banks is run on a sample that includes years prior to 2004. Column (7) includes all years beginning with 2004. The sample split highlights that banks other than the top five are responsible for the effect on export growth in the early years of the sample, whereas the top five banks drive the effect in the later years. This finding is likely explained by the fact that the market shares of the top five banks steadily rose over the sample period. Since the banking sector went through a prolonged phase of consolidation, the impact of the top five banks on the total supply of trade finance increased as smaller banks exited and the trade finance business became more concentrated.

## 5.2 Heterogeneous Effects

In this section, we explore whether effects differ over time and across countries. In table 12, the sample is split into the crisis and the non-crisis period, respectively. The crisis period goes from the third quarter of 2007 to the second quarter of 2009. The non-crisis period includes all other dates. When the export equation (equation 3) is estimated only on the crisis sample, the effect of letter of credit supply shocks is highly significant at a 1 percent significance level and the point estimate of  $\gamma$  in column (1) is much larger than for the non-crisis sample in column (2). The shock coefficient of 0.183 in column (1) suggests that a country-level shock of one standard deviation decreases exports by more than 3 percentage points during periods of financial distress. This means that the effect of a reduction in the supply of LCs doubles during a crisis compared to the

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<sup>38</sup>We take the five bank with the largest trade finance claims over the sample period and also include merged entities that were separate banks in earlier years.

average effect reported before. To test formally for differences in the effect over time, we include an interaction term between the shock and a dummy variable for the crisis period in column (3) of table 12. The coefficient of the interaction term is significant at a 10 percent level and confirms the differences in magnitudes obtained from the sample split.

The effect of LC supply shocks on export growth does not only vary over time but also across export destinations. In columns (4) and (5) of table 12, the effect of LC supply shocks is estimated based on a sample that only includes small and large export destinations, respectively. We define a country to be small if its log exports over the sample period lies below the sample median. Thus the designation of a country into small or large is constant over time.<sup>39</sup> Reductions in the supply of LCs only have an effect on small export destinations. While the point estimate of the shock is highly significant and takes a value of 0.189 for small countries in column (4), it is essentially zero and insignificant when only large export destinations are included in the sample in column (5). The difference is confirmed in column (6), in which an interaction term between the shock and a dummy variable for small countries is included, although the coefficient of the interaction is only marginally significant at a 12 percent level. In a next step, we jointly investigate differences over time and across countries. Column (7) includes only small countries and the recent crisis period. In column (8), the export equation is estimated on the full sample and includes now both the crisis interaction and the market size interaction. These additional regressions clearly show that the effect of LC supply shocks on export growth to large countries in normal times is close to zero, while the effect is strongest for exports to small destinations in times of financial distress in the U.S. economy. Then a negative LC supply shock of one standard deviation can lead to a reduction in exports of more than 4 percentage points.

To check whether it is really the size of an export market that leads to differences in the effect across countries, we explore alternative sample splits and introduce interaction terms between the shocks and different variables. The evidence suggests that a crucial determinant of the strength of the effect on export growth is the number of U.S. banks

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<sup>39</sup>Countries designated as small are listed in the data appendix.

that provide LCs for exports to a given destination country as shown in table 13. In column (1), the export regression is estimated only for countries in which less than five U.S. banks are active in quarter  $t - 1$ . Column (2) shows the results for countries with at least five banks and column (3) is based on the full sample and adds interaction terms. The effect of LC supply shocks on export growth is clearly larger for countries in which less than five banks are active. The interaction term between a dummy for countries with at least five U.S. banks is large, negative and significant at a 5 percent level. As shown in section 4.3, a destination's risk, GDP per capita, size and distance to the U.S. determine the number of banks. Therefore, the effect tends to be larger not only for small countries but also for countries with a low GDP per capita and a weak rule of law.

The presented results indicate that export growth to small countries is particularly affected if banks contract their supply of LCs. This is easy to rationalize. First, only a few U.S. banks provide LCs for small destinations. If one of the banks active in those markets reduces its supply, it is especially difficult for trading partners to find an alternative. Second, selling to destinations with a low GDP per capita or a weak rule of law might not be profitable for the exporter without an LC since the firm's implicit cost of conducting the transaction without a guarantee may be high. At the same time, trade insurance, which is an alternative to an LC, is more likely to be unavailable or very costly.

Our second finding, that the effect of supply shocks is larger during a crisis period, can also be explained by similar factors. During a period of financial distress, trading partners may find it harder to switch to another bank when the core bank refuses to issue or confirm an LC. Other banks may be less willing to expand their trade finance business to a new market during these times, and banks with existing relationships to intermediaries in a foreign country may not be able to obtain liquidity or may not want to add risk to their balance sheets. At the same time, exporters and importer may be more reluctant to trade without an LC as they are more risk averse.

### 5.3 Identification and Robustness

In this section, we present several robustness checks. In particular, we address the concern that the constructed country-level shocks might not be entirely purged of demand effects. To that end, we provide different pieces of evidence that banks do not specialize in certain industries. We also show that the results are robust to lagging banks' market shares by an alternative number of periods when constructing the country-level supply shocks. Combined with our previous observation that the estimated bank-level shocks are negatively serially uncorrelated, this practically eliminates any concern that there could be an endogeneity problem due to sorting of banks into markets.

Before addressing identification issues further, we run two placebo regressions. In column (1) of table 18, export growth is regressed on the shock variable lagged by one year. In column (2), the dependent variable is replaced. Instead of U.S. export growth, we use growth in exports of the EU15 countries to destination  $i$  in quarter  $t$ .<sup>40</sup> Accordingly, we do not include growth in non-U.S. exports as control variable in the regression. In both columns, the estimated shock coefficient is close to zero and insignificant, as we would expect. The effect of shocks to the supply of letters of credit by U.S. banks is unique to U.S. exports and is associated with a particular time period. In column (3), we include country-specific linear time trends in the regression in addition to time and country fixed effects. This has essentially no effect on the magnitude and significance of the shock coefficient compared to the baseline result in column (3) of table 11. Thus we can exclude that results are due to an omitted variable that exhibits a time trend and is correlated with both the shocks and export growth.<sup>41</sup> In column (4), we present a robustness check that addresses concerns related to our sample selection when estimating bank-time fixed effect. Recall that we deleted observations for which  $tf_{bct}$  was equal to zero (see the discussion in section 4.2) when estimating equation 1. To avoid the exclusion of zeros, we compute growth rates using the formula  $2 \frac{tf_{bcd} - tf_{bct-1}}{tf_{bcd} + tf_{bct-1}}$  suggested by Davis et al. (2007). These alternative growth rates are regressed on bank-

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<sup>40</sup>The EU15 countries include: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, the United Kingdom.

<sup>41</sup>We also checked that results are robust to excluding the period after 2009, in which U.S. banks expanded their trade finance business in particular in Asia.

time fixed effects  $\alpha_{bt}$  and country-fixed effects  $\beta_{ct}$ .<sup>42</sup> The obtained bank-time fixed effects are normalized and used to compute country-level shocks as before. Column (4) shows that the inclusion of zeros in the sample does not change the results. The estimated effect of letter of credit supply shocks on export growth has a similar magnitude and remains significant at a level of around 5 percent.

Despite our methodology and the presented robustness checks, the skeptical reader may still be concerned that the estimated supply shocks could be endogenous to demand effects. There is one case under which bank shocks could pick up demand effects. If banks were fully specialized in one or several industries and there was a shock to demand or production in these industries, then the estimated bank shocks could reflect industry effects. If there was substantial specialization, dropping country  $i$  information from the sample would not be sufficient to eliminate demand effects because shocks to the trade finance claims of bank  $b$  in other countries would be driven by the same industry effects.

To see this, consider the following example. Assume that there are two banks. Bank A specializes in confirming LCs for machinery, and bank B provides guarantees for exports of textiles. Suppose there is a shock to the supply of or the global demand for machinery so that exports in that industry increase. Then bank A faces a higher demand for trade finance and its trade finance claims increase. Because bank A sees an increase in the demand for LCs but not bank B, the estimation strategy could fail to filter out the demand effect. The increase in the demand for trade finance could then show up as a positive shock to bank A's supply of trade finance. When exports of machinery increase to all destination countries, bank shocks identified without the inclusion of bank A's trade finance claims in country  $i$  would still be correlated with exports to country  $i$ .

We address this issue in several different ways. First, note that we have shown that the estimated bank shocks are correlated with relevant bank-level variables such as loan growth and banks' credit default swap spreads, which is evidence that the shocks reflect changes in the supply of trade finance. Second, it is unlikely that banks specialize in industries or that exports of single firms could drive changes in the trade finance claims of single banks and aggregate export growth rates at the same time. There are only a

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<sup>42</sup>To mitigate the effect of outliers as before, we exclude the first and the 99th percentile of the distribution.

few banks that provide trade finance, while there are many more firms and industries. So the mere fact that the provision of guarantees is concentrated in a few large banks makes specialization improbable. Also, the largest firms are less likely to rely on LCs. Larger firms have longer lasting relationships and are better able to cope with risks, since they are big and can diversify within the firm. Moreover, a substantial amount of their trade is intra-firm and does not require bank guarantees. Third, banks should seek to spread trade financing over different industries and firms. On one hand, banks want to diversify risks. On the other hand, the costs associated with gathering LC relevant information about a destination and establishing a network of “correspondent banks” is likely much higher than the cost of acquiring knowledge about an industry.

While we do not observe which bank clients obtain trade financing, we can test for specialization directly. Specialization would imply, first, that a bank’s share in the total trade finance claims of country  $i$  is correlated with the country-level export share of the industry in which the bank specializes. Second, the estimated bank shocks would be correlated with specific industry shocks. To check for evidence of the former relationship, we regress a particular bank’s trade finance shares that vary across countries and over time on the export shares of different industries, which also vary across countries and over time. We split industries into fourteen groups.<sup>43</sup> The regression equation reads as follows:

$$\phi_{it}^b = \sigma^k \text{ industry share}_{it}^k + \delta_i + \psi_{it}, \quad (5)$$

where  $\phi_{it}^b = \frac{t f_{ibt}}{\sum_b^B t f_{ibt}}$  and  $\text{industry share}_{it}^k = \frac{X_{ikt}}{\sum_k^K X_{ikt}}$ .  $X_{ikt}$  stands for the exports in industry  $k$  to country  $i$  at time  $t$ . This regression is estimated for each bank  $b$  and each industry  $k$ .

In a next step, we obtain industry shocks  $\alpha_{kt}$  by running the following regression:

$$\Delta X_{kit} = \alpha_{kt} + \beta_{it} + \epsilon_{kit}, \quad (6)$$

where  $\Delta X_{kit}$  reflect the growth in U.S. exports to destination  $i$  in industry  $k$  at time

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<sup>43</sup>These are Stone & Glass; Chemicals & Allied Industries; Transportation, Raw Hides, Skins, Leather, & Furs; Miscellaneous; Machinery & Electrical; Wood & Wood Products; Footwear & Headgear; Plastics & Rubbers; Food; Textiles; Mineral Products; Metals; Other.

$t$ . As with the bank-level shocks, we regress the estimated industry shocks  $\alpha_{kt}$  on time fixed effects and work with the residuals  $\hat{\alpha}_{kt}$ . Then we regress the average bank shocks  $\bar{\alpha}_{bt}$ , bank by bank, on the different industry shocks:

$$\bar{\alpha}_t^b = \theta^k \hat{\alpha}_t^k + \xi_t. \quad (7)$$

Table 15 displays the results for the five largest banks. Each column presents the estimated coefficients for a particular bank. Each row reflects a particular industry. Even columns show the coefficients obtained from estimating equation 5 ( $\sigma^k$ ), odd columns those from estimating equation 7 ( $\theta^k$ ). The table indicates that the trade finance shares of banks do not co-vary systematically with the export shares of particular industries. Also industry shocks do not explain bank shocks. Note that it is not a concern that some of the coefficients in table 15 are positive and significant. Specialization would imply that  $\sigma^k$  and  $\theta^k$  are both positive and significant for a particular bank  $b$  and industry  $k$  but this is never the case. We also ran regressions for the other banks in our sample and regressed the log of the trade finance claims of a particular bank on the log of exports in different industries. Each bank's trade finance claims are correlated with exports in more than one industry. At the same time, exports of the same industry explain the variation in the trade finance claims of multiple banks. There is no indication that banks specialize and serve only a single industry or large firm and that this could drive the presented results.

To address the potential endogeneity problem more directly, we exclude a larger set of countries when estimating equation 1. Trade patterns are more dissimilar, the more different destination countries are in terms of their geographic location and stages of development. Hence, we drop not only information on country  $i$  but also on the entire region in which country  $i$  is located to obtain the bank-level shocks  $\alpha_{ibt}$  that are used to compute the aggregate supply shock of country  $i$ . We split countries into eight regions: East Asia and Pacific, Europe and Central Asia, High-income OECD members, High-income non-OECD members, Latin America and the Caribbean, the Middle East and North Africa, South Asia, and Sub-Saharan Africa. The results are qualitatively the same, as columns (1) to (3) of table 16 shows.

Next, we use only observations for the large countries in the sample to estimate equation 1. Thus we obtain bank-time fixed effects that exclusively reflect the growth or contraction of trade finance by U.S. banks in the large export destinations. We use these bank-level shocks to construct country-level supply shocks as before and rerun the regressions on the sample of small and large countries.<sup>44</sup> Columns (4) to (7) of table 16 presents the results. When the export equation is estimated based on the sample of large countries, the effect of letter of credit supply shocks is close to zero and insignificant. If the bank-level shocks picked up industry effects, then we would expect to find a significant effect in columns (4) and (5) but this is not the case. However, the effect of a reduction in the supply of trade finance is positive and significant at a 10 percent level, when we run the regression only on the sample of small countries (see column (6)). Thus information on trade finance supplied to large countries does not predict U.S. export growth in large destinations but in small ones. The samples of small and large countries do not systematically vary in their ratio of trade finance claims to U.S. exports. This is strong evidence against the hypothesis that the shocks in our baseline regression incorporate demand effects to generate the presented findings.

To provide even more evidence that specialization cannot drive our results, we conduct one more exercise, exploiting information on the types of goods that the U.S. ships to various destinations. In a first step, we compute the average share  $\bar{s}_{ki}$  of industry  $k$  in U.S. exports to country  $i$  over the sample period. Then, we compute for each country  $i$  and each country  $j$  the sum of squared differences in industry shares between the two countries using the following formula:  $\sum_{k=1}^K (\bar{s}_{ki} - \bar{s}_{kj})^2$ . Next, we rank countries according to how similar they are to country  $i$ . This information is then used to systematically exclude countries from the sample on which the bank shocks for country  $i$  are estimated. Specifically, we always exclude the 30 countries that are closest to country  $i$  (in terms of the industry structure of their U.S. imports) when estimating equation 1 for country  $i$ . The estimated bank-level shocks are aggregated to obtain country-level shocks as before. The results of this exercise are shown in table 17. The effect of letter of credit supply shocks on export growth is still large and highly significant. That is, even when we exclude those countries that are the most similar in terms of the goods they import

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<sup>44</sup>For a list of countries designated as small, see the data appendix.

from the U.S. when we estimate the bank-level shocks, the results still hold.

The previous discussion addresses concerns that the idiosyncratic bank shocks we obtain could be endogenous to export growth. Any remaining endogeneity between country-level shocks and export growth rates must thus come through banks' market shares. The identification assumption would be violated if banks with positive shocks in period  $t$  were to provide more trade finance in period  $t - 2$  to markets with positive deviations from trend export growth in period  $t$ .

In columns (1), (2) and (3) of table 18, banks' market shares are lagged by one, three and four quarters, respectively, when computing the country shocks  $\Delta tf_{ct}$ , in contrast to the two-quarter lags used in the baseline specification. In column (4), four-quarter rolling averages of banks' market shares lagged by one period are used. In column (5), the yearly average market share of each bank is applied to construct the country-level shocks in the next year. The effect of supply shocks on export growth remains significant at a 10 percent level throughout. Given these results, our identification strategy could be violated only if banks that anticipate growing in period  $t$  sort, in period  $t - 1$ ,  $t - 2$ ,  $t - 3$  and  $t - 4$ , into markets with higher deviations from trend export growth in period  $t$ . We have shown in section 4.3 that the estimated bank-level shocks are negatively serially correlated. The fact that all four lags work is therefore inconsistent with systematic sorting of banks period by period. This would only be possible with positively serially correlated shocks.

## 6 Quantifying the Effect of Supply Shocks

To explore, in greater detail, the magnitude of the effect of supply shocks on exports, we conduct the following experiment. We assume that a major trade finance provider experiences a negative supply shock that corresponds to the 10th percentile of the bank shock distribution (a value of -0.426). Using this bank's market share in each destination country in the fourth quarter of 2011 and export values in the first and second quarters

of 2012, the predicted aggregate effect on export growth is calculated as follows:

$$\Delta X_t = \frac{\sum_{c=1}^N (\gamma(-0.53)\phi_{cbt-2}X_{ct-1})}{X_{t-1}}. \quad (8)$$

We set  $\gamma$  equal to 0.0888, which corresponds to the estimated coefficient in column (3) of table 11. The calculations predict that such a trade finance supply shock would reduce aggregate U.S. export growth by around 1.4 percentage points. This shows that a reduction in the supply of trade finance by one large bank in the U.S. would have a significant effect on exports.

It does matter which bank is subject to the shock. In a next step, we choose two large trade finance suppliers and calculate the effect on export growth in selected regions of the world when each of them is hit by the shock described above. Columns (1) and (2) of table 19 show the results. Whereas exports in South Asia would fall by 0.41 percentage point if bank A were hit by the shock (see column (1)), the same relative reduction in trade finance by bank B would reduce exports in this region by 1.86 percentage points (see column (2)). An even stronger asymmetry arises for Sub-Saharan Africa. This example illustrates that banks, through their global operations, can influence export patterns. The same bank shock affects countries differentially, depending on how important the bank is for the provision of LCs in each export market.

So far, the we focused on what happens when only one of the banks reduces its supply of trade finance. Next, we analyze the effect on exports if all banks were hit by a moderate shock that corresponds to the 25th percentile of the bank-level shock distribution (a value of  $\alpha_{bt} = -0.245$ ) and roughly to half of the shock considered before. Using the estimated loan growth coefficient in column (4) of table 11, aggregate U.S. exports would fall by around 2.2 percentage points. According to the results presented in section 5, the effect of letter of credit supply shocks is larger during a crisis period. Based on the coefficient in column (3) of table 12, the effect would double to 4.4 percentage points.<sup>45</sup>

There is also evidence that the effect of shocks varies across countries. Smaller

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<sup>45</sup>Relative to non-crisis times the effect more than doubles.

export markets are more affected than larger markets by a reduction in the supply of trade finance. To account for this, we calculate the effect of supply shocks now based on the estimated relationship in column (8) of table 12 for different regions of the world during crisis times. Compared to other regions, sub-saharan Africa would be hit particularly hard by a reduction in the supply of letters of credit as (4) of table 19 shows, since this region hosts many small export markets. Overall the quantifications suggest that reductions in the supply of trade finance can substantially reduce export growth, especially in small countries and during periods of financial distress. Big shocks to a single large bank and moderate shocks to many banks can have the same effect in the aggregate but they may affect exports to different destinations differentially.

As a final exercise, we compare the effect of an LC supply shock to the effect of an exchange rate shock. According to the estimated coefficient in column (3) of table 12, a 10-percent appreciation of the USD against the local currency of the importing country reduces U.S. exports by 2.53 percentage points. Hence, the effect of a negative LC supply shock of one standard deviation during a crisis episode generates the same reduction in trade as an appreciation of the USD by 12.3 percent. This shows that LC supply shocks have an economically significant effect on export growth compared to another major factor.<sup>46</sup>

These results are relevant for the ongoing debate on trade finance and the Great Trade Collapse. While our estimation strategy does not allow us to identify aggregate supply shocks, the evidence presented in this paper suggests that trade finance may have played a magnifying role. When the banking sector as a whole is in distress, reductions in the supply of trade finance by single banks have larger effects. First, exporters may find it harder to switch to other banks. These may be less willing to expand their balance sheets or to cooperate with new banks in foreign countries when uncertainty is high and liquidity limited. Second, firms may be more reluctant to trade without a letter of credit.

Several works do not find a role for trade-specific financial instruments in the 2008/2009 crisis (e.g., Del Prete and Federico (2014) and Rhee and Song (2013)) or they find that shocks to the supply of loans do not have differential effects across export destinations

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<sup>46</sup>We estimate the contemporaneous exchange rate elasticity of U.S. exports. Estimates of the long-run elasticity are typically higher. See, for example Hooper et al. (2000).

(see Paravisini et al. (forthcoming)). As documented in this paper, the effect of reductions in the supply of LCs is heterogeneous across countries. Studies that do not take this heterogeneity into account may have a hard time finding any effect. At the same time, one would expect the working capital channel to work differently than the risk channel. First, working capital needs associated with a transaction are independent of destination risk. In contrast, exporters demand LCs if they fear that they will not get paid. Second, because credit is fungible, firms can reallocate funds internally and devote them to the most profitable activities. In contrast, an LC is destination specific and tied to particular export transaction and trading partner.

## 7 Conclusions

Exploiting data on the trade finance claims of U.S. banks that vary across countries and over time, this paper sheds new light on the effects of financial shocks on trade. While existing studies emphasize the working capital channel, this work provides evidence for the risk channel. We show that shocks to the supply of LCs – a trade-specific, risk-reducing financial instrument – have statistically and economically significant effects on exports.

While we follow the strategy of Greenstone and Mas (2012) and Amiti and Weinstein (2013) to identify supply shocks from the data, we modify and add new elements to the methodology. First, we estimate bank shocks over multiple periods and propose a normalization to make bank shocks comparable across time. Second, we obtain bank shocks separately for each country and show how to systematically drop information on similar countries to counter endogeneity concerns that may arise. Third, we demonstrate how sorting into markets can be excluded by jointly looking at serial correlation in bank shocks and by estimating the model using different lags of the market shares. These innovations can be useful for future empirical work.

Applying the approach, we find that exports to countries that are poorer and smaller, where fewer U.S. banks are active, are more affected when banks reduce their supply of trade finance. At the same time, changes in supply have much stronger effects during

times of financial distress. Another key result of the analysis is that single banks can affect exports in the aggregate. Due to the high concentration of the business, a large negative shock to one of the big U.S. trade finance banks reduces aggregate exports by 1.4 percentage points. This effect more than doubles during times of financial distress. The presented findings suggest that trade finance can constrain exports, especially to the poorer and smaller destinations and during crises episodes. Considering that reductions in the supply of LCs are associated with a contraction in bank lending and a rise in banks' credit default swap spreads, trade finance may have a role in explaining the collapse in exports to the smaller and poorer countries in 2008/2009.

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# Data Appendix

## Data sources

- U.S. banks' trade finance claims: FFIEC009 Report, Statistics Group, New York Fed.
- SWIFT MT700 messages received by U.S. banks: the SWIFT Institute.
- Quarterly trade data: IMF Direction of Trade Statistics.
- Quarterly industry-level trade data: Census Bureau.
- Bank balance sheet data: FFIEC031 or Y9c reports. Where available, FFIEC031 information was aggregated up for each Bank Holding Company to match the FFIEC009 reporting level.
- Quarterly GDP was obtained from national statistical agencies via Haver Analytics' Data Link Express (DLX) Software.
- Annual population, GDP per capita: World Development Indicators, the World Bank.
- Rule of law: World Government Indicators, the World Bank.
- Distance: CEPII (see Head et al. (2010)).
- Exchange rates: International Financial Statistics, IMF.
- Quarterly credit default swap spreads on senior unsecured debt with maturity 6 months in USD: Markit.com. Matching between ticker names and IDRSSDs was done manually. Quarterly data was obtained by averaging the monthly data.

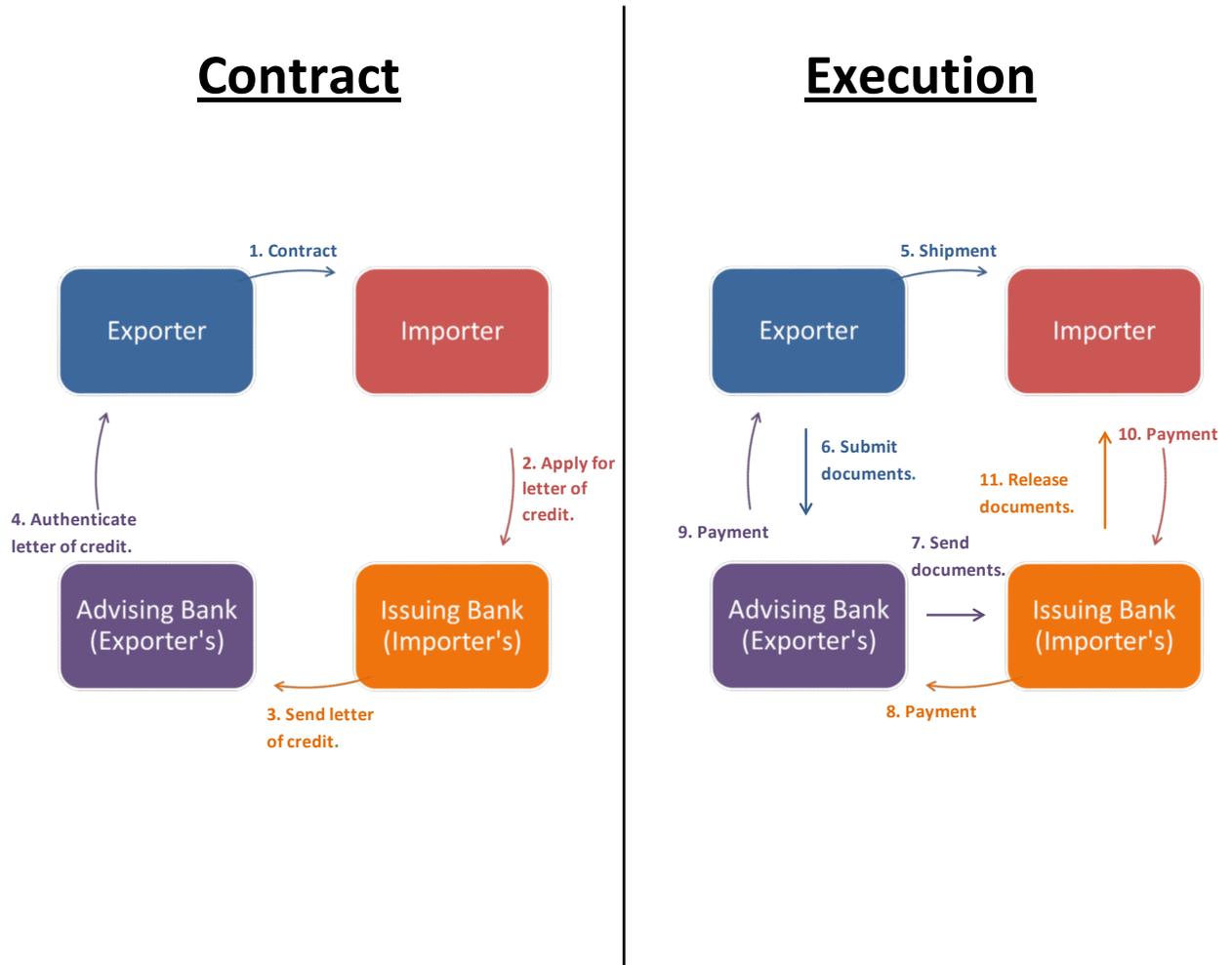
## List of countries

- Countries designated as offshore financial centers: Netherlands Antilles, Antigua and Barbados, Azerbaijan, Bahrain, Bahamas, Belize, Bermuda, Barbados, Cay-

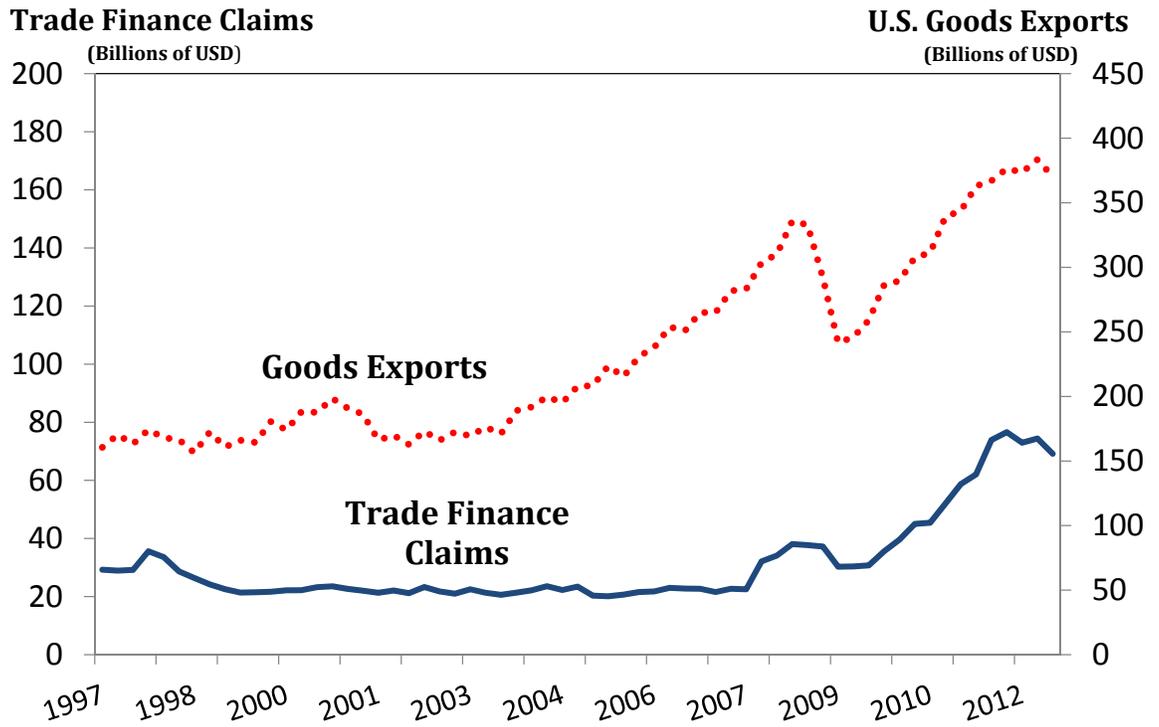
man Islands, Cyprus, Dominica, Grenada, Hong Kong, Ireland, Jordan, Lebanon, Macao, Monaco, Maldives, Malta, Mauritius, Seychelles, Vanuatu, Samoa.

- Countries designated as small export destinations: Afghanistan, Algeria, Angola, Armenia, Azerbaijan, Bahrain, Bangladesh, Barbados, Belarus, Belize, Benin, Bermuda, Bolivia, Botswana, Brunei Darussalam, Bulgaria, Burkina Faso, Cabo Verde, Cambodia, Cameroon, Democratic Republic of Congo, Republic of the Congo, Cote d'Ivoire, Croatia, Cyprus, Czech Republic, Denmark, Djibouti, Estonia, Ethiopia, Fiji, French Polynesia, Gabon, Georgia, Ghana, Greece, Guinea, Guyana, Haiti, Hungary, Iceland, Iraq, Jordan, Kazakhstan, Kenya, Latvia, Lebanon, Liberia, Libya, Lithuania, Luxembourg, Macau, Macedonia, Madagascar, Malawi, Maldives, Mali, Malta, Mauritania, Mauritius, Mongolia, Morocco, Mozambique, Namibia, Nepal, Netherlands Antilles, New Caledonia, Nicaragua, Oman, Pakistan, Papua New Guinea, Paraguay, Portugal, Qatar, Romania, Rwanda, Samoa, Senegal, Slovakia, Slovenia, Sri Lanka, Sudan, Suriname, Swaziland, Syria, Tanzania, Togo, Trinidad & Tobago, Tunisia, Turkmenistan, Uganda, Ukraine, Uruguay, Uzbekistan, Yemen, Zambia, Zimbabwe.

Figure 1: How a letter of credit works

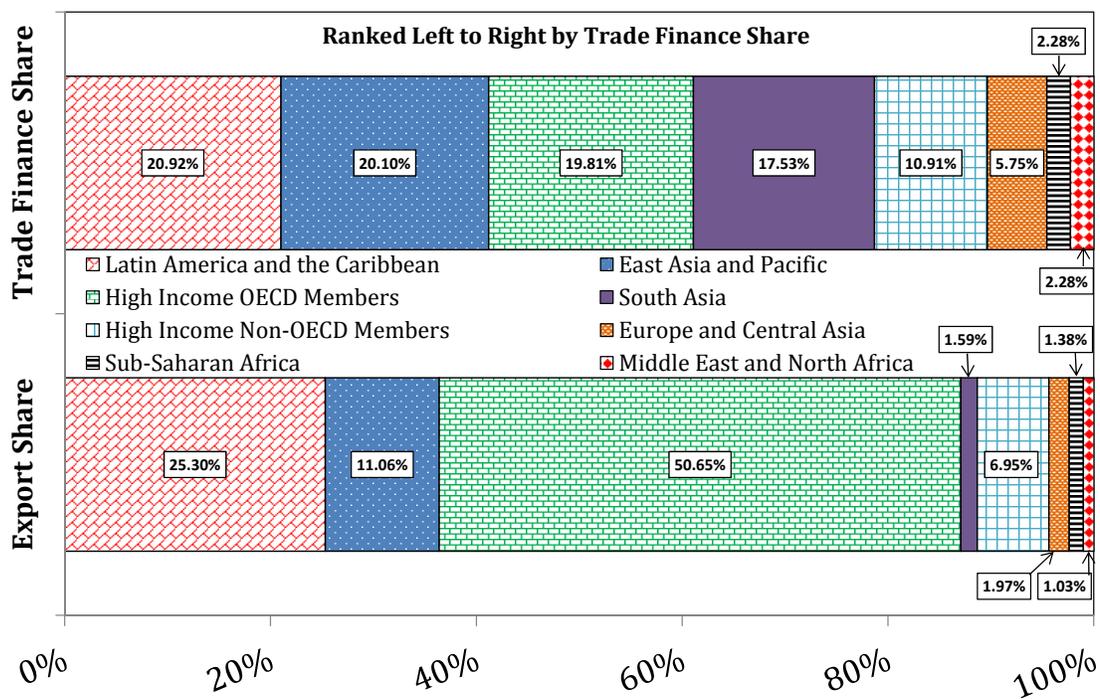


**Figure 2:** Evolution of aggregate trade finance claims and U.S. exports over time



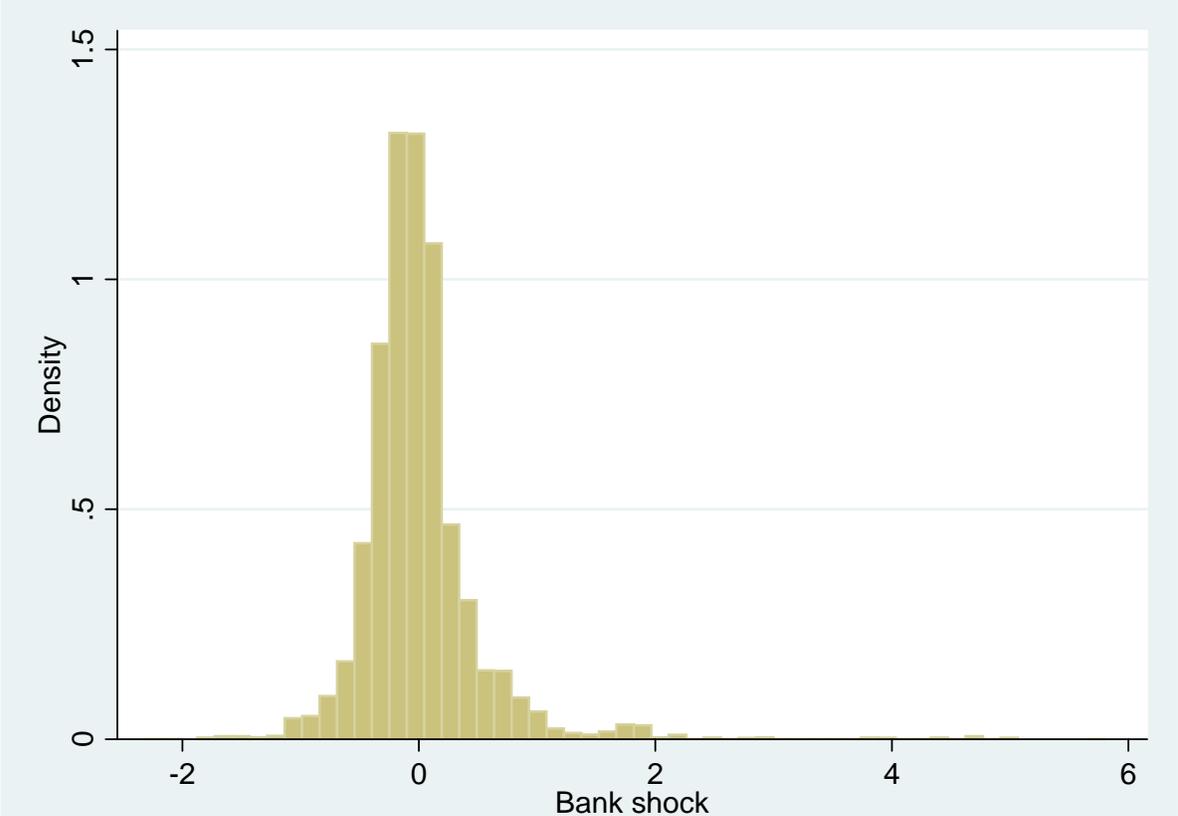
Note: The solid line in the graph shows the aggregate trade finance claims of all reporting U.S. banks over time. The years 1997-2000 exclude data from one large bank that changed its trade finance business fundamentally in the reporting period. The dotted line displays the evolution of aggregate U.S. exports in goods over time.

**Figure 3:** Trade finance and export shares in 2012 q2 by world region



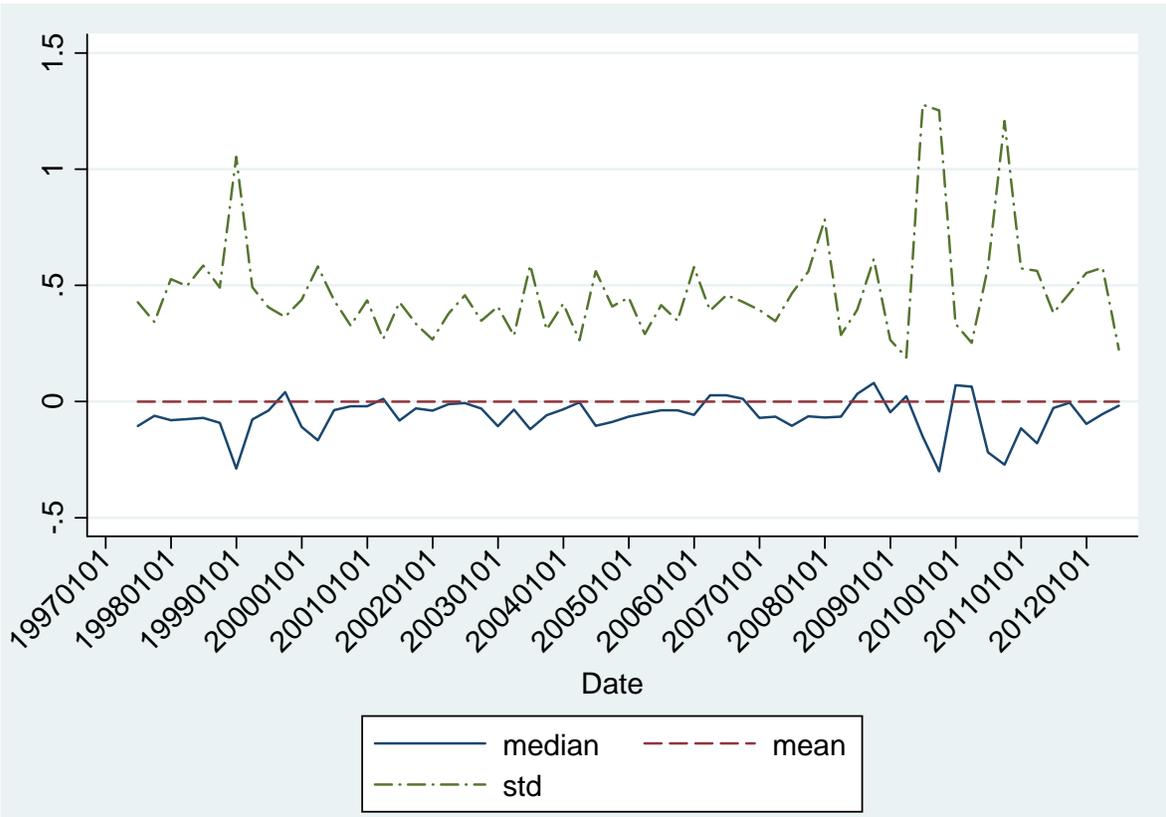
Note: The upper bar in the graph shows the shares of eight groups of countries in banks' total trade finance claims in 2012 q2. The lower graphs displays each group's share in total U.S. goods exports in that quarter.

**Figure 4:** Distribution of bank supply shocks



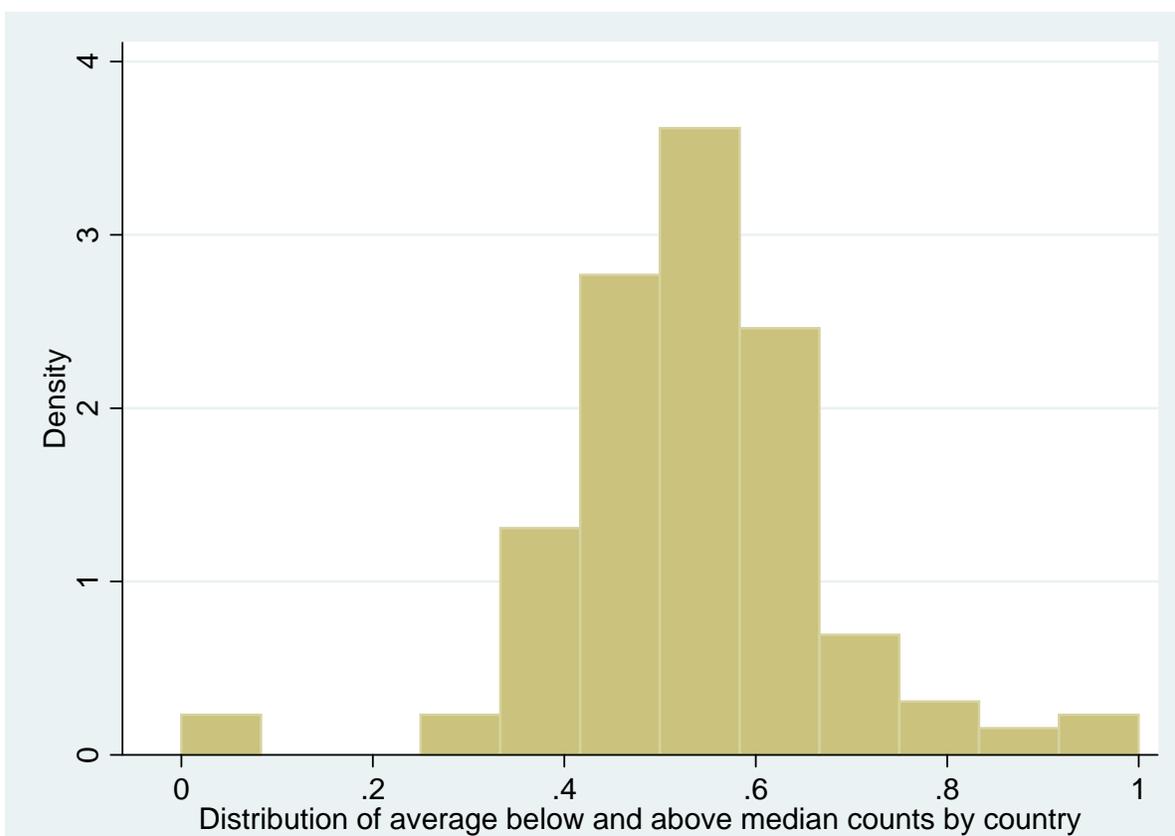
Note: The graph shows the histogram of the 325,389 bank-level shocks that are estimated based on the trade finance data.

**Figure 5:** Mean, median and standard deviation of bank supply shocks over time



Note: The solid line in the graph shows the median bank-level supply shock over time. The dashed line displays the mean shock. The dash-dotted line reflects the standard deviation of the bank shocks in each quarter.

**Figure 6:** Evidence for random distribution of shocks across countries



Note: The histogram shows the distribution of country means of a dummy variable that takes value 1 if country  $i$  is hit by an above median shock in period  $t$  and zero otherwise. If shocks are randomly distributed across countries, then the means should be distributed symmetrically around 0.5.

**Table 1:** Possible instruments and underlying trade transactions in the data

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

Note: *X* indicates that this type of trade transaction could be included in the FFIEC 009 data based on the reporting instructions.

**Table 2:** Exploring the claims data

	(1)	(2)	(3)	(4)	(5)	(6)
dep. var $\log(\text{tf})_{ct}$						
$\log(\text{exports}_{ct})$	0.861*** (0.0886)	0.851*** (0.0903)	0.245*** (0.0595)	0.482*** (0.0473)	0.411*** (0.0506)	0.320*** (0.106)
$\log(\text{imports}_{ct})$	-0.0274 (0.0712)	-0.0310 (0.0741)	0.0193 (0.0438)			
$\log(\text{non-U.S. exports}_{ct})$	0.0672 (0.140)	0.0405 (0.142)	-0.0339 (0.119)			
$\log(\text{non-U.S. imports}_{ct})$	-0.112 (0.155)	-0.0538 (0.163)	0.173 (0.172)			
$\log(\text{GDP per cap}_{ct})$	-0.224** (0.0891)	-0.217** (0.0902)	0.931*** (0.232)			
$\log(\# \text{ of SWIFT messages}_{ct})$				0.591*** (0.0521)	0.636*** (0.0558)	0.283*** (0.0823)
Time FE	No	Yes	Yes	No	Yes	Yes
Country FE	No	No	Yes	No	No	Yes
Observations	6,599	6,599	6,599	3,383	3,383	3,383
R-squared	0.550	0.559	0.833	0.678	0.699	0.870

Note: This table analyzes the relationship between trade finance claims from the FFIEC 009 form, trade and the number 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. The variable  $\# \text{ of SWIFT messages}_{ct}$  represents the number of MT700 (LC) messages received by U.S. banks from country  $c$  in quarter  $t$ . Clustered standard errors are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 3:** Summary statistics of banks' market shares and the number of banks by country

	date	N	mean	std.	min	max
$\phi_{ibt}$	2000 q1	758	0.151	0.250	0.0003	1
	2006 q1	453	0.256	0.314	0.0003	1
	2012 q1	484	0.277	0.324	0.0001	1
$n_{it}$	2000 q1	115	6.591	6.569	1	34
	2006 q1	116	3.905	2.871	1	14
	2012 q1	134	3.612	2.810	1	13

Note: This table reports summary statistics based on data from the Country Exposure Report (FFIEC 009).  $\phi_{ibt}$  is the share of the trade finance claims of bank  $b$  in the total trade finance claims of country  $i$  at time  $t$ .  $n_{it}$  is the number of banks with positive trade finance claims in country  $i$  at time  $t$ .

**Table 4:** Persistence in banks' market shares

dep. var. $\phi_{ibt}$	(1)	(2)	(3)
$\phi_{ibt-1}$	0.913*** (0.00331)		0.704*** (0.0132)
$\phi_{ibt-2}$		0.880*** (0.00399)	0.236*** (0.0132)
Observations	32,896	29,538	28,196
R-squared	0.836	0.773	0.854

Note: This table analyzes the persistence of banks' market shares within countries. The dependent variable is the share of the trade finance claims of bank  $b$  in the trade finance claims of all banks in country  $i$  at time  $t$ . All regressions include a constant. Robust standard errors are in parentheses. \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 5:** Persistence in the number of banks active in a market

dep. var. $n_{it}$	(1)	(2)	(3)
$n_{it-1}$	0.956*** (0.00440)		0.690*** (0.0173)
$n_{it-2}$		0.925*** (0.00547)	0.265*** (0.0173)
Observations	6,914	6,697	6,587
R-squared	0.947	0.924	0.950

Note: This table analyzes the persistence of the number of banks active in a trade finance market. The dependent variable is the number of banks with positive trade finance claims in country  $i$  at time  $t$ . All regressions include a constant. Robust standard errors are in parentheses. \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 6:** Determinants of the number of banks active in a market

dep. var. $\log(n_{it})$	(1) 2010 q1	(2) 2004 q1	(3) all quarters
$\log(\text{U.S. exports}_{it})$	0.307*** (0.0236)	0.323*** (0.0288)	0.337*** (0.0164)
$\log(\text{distance}_i)$	0.145* (0.0738)	-0.0853 (0.116)	-0.0440 (0.0601)
rule of law $_{it}$	1.850* (1.006)	2.953* (1.572)	2.764*** (0.850)
rule of law $_{it}^2$	-2.137*** (0.804)	-3.712*** (1.146)	-3.137*** (0.645)
$\log(\text{GDP per cap.}_{it})$	0.106* (0.0610)	0.238*** (0.0652)	0.126*** (0.0393)
Constant	-7.371*** (0.721)	-6.300*** (1.162)	-5.882*** (0.609)
Observations	115	107	5,272
R-squared	0.724	0.660	0.686

Note: This table analyzes the factors that determine the number of banks that have positive trade finance claims in a destination country. Column (1) is based on the cross-section of the first quarter of 2010, column (2) on the cross-section of the first quarter of 2004. The sample underlying column (3) includes all years. Robust standard errors are in parentheses in columns (1) and (2). Standard errors clustered by country are in parentheses in column (3). \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 7:** Summary statistics

variable	(1) N	(2) mean	(3) sd	(4) min	(5) max
trade finance growth $\Delta t f_{bct}$	32,256	0.225	1.049	-.904	9.8
bank shock $\hat{\alpha}_{ibt}$	325,389	0	0.500	-2.316	5.806
country-level shock $\hat{\alpha}_{it}$	6,751	0.030	0.171	-0.97	2.202
country-level shock $\hat{\alpha}_{it}$ in sample with controls	4,904	0.032	0.174	-0.971	1.813
export growth $\Delta X_{it}$ in sample with controls	4,904	0.057	0.309	-.667	2.06

Note: In the first row, summary statistics of trade finance growth rates are given that are observed in the sample that is used to estimate equation 1. The second row provides summary statistics of the normalized bank shocks that are obtained from estimating equation 1, always dropping country  $i$  from the sample. The summary statistics of the country-level shocks in the third row are for all country-level shocks that are computed. In the fourth column only those country-level shocks are included that are used in the estimation of equation 3 with controls. The last row displays summary statistics of the corresponding export growth rates.

**Table 8:** Correlation of estimated bank shocks with bank-level variables

dep. var $\bar{\alpha}_{bt}$	(1)	(2)	(3)	(4)	(5)	(6)
deposit growth $_{bt}$	0.454 (0.354)			0.216 (0.245)	0.231 (0.347)	
loan growth $_{bt}$		0.492 (0.305)		0.385* (0.210)	0.779 (0.574)	
charge-offs growth $_{bt}$			-6.58e-05*** (2.27e-05)		-6.02e-05** (2.40e-05)	
CDS spread $_{bt}$						-0.0124* (0.00672)
Time FE	yes	yes	yes	yes	yes	no
Bank FE	no	no	no	no	no	yes
Observations	1,887	1,887	1,169	1,887	1,169	270
R-squared	0.012	0.016	0.021	0.017	0.046	0.124

Note: This table analyzes the relationship between the estimated bank shocks and bank-level variables. The dependent variable is the mean bank shock  $\bar{\alpha}_{bt}$ , which corresponds to the value of  $\hat{\alpha}_{ibt}$  averaged over all countries. Charge-offs growth is the growth rate in real estate charge-offs. CDS spread is the bank-specific current default swap spread of bank  $b$  at time  $t$ . All regressions include a constant. Standard errors are in parentheses. \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 9:** Predicting observed trade finance growth rates using bank-level shocks

dep. var $\Delta t f_{ibt}$	(1)	(2)	(3)
$\hat{\alpha}_{ibt}$	0.305*** (0.0521)	0.307*** (0.0531)	0.326*** (0.0680)
Country FE	no	yes	no
Time FE	no	yes	no
Time $\times$ County FE	no	no	yes
Observations	32,025	32,025	32,025
R-squared	0.002	0.009	0.142

Note: This table analyzes the relationship between the country-specific bank-level shock  $\hat{\alpha}_{ibt}$  and the observed growth  $\Delta t f_{ibt}$  in bank  $b$ 's trade finance claims in country  $i$  at time  $t$ . All regressions include a constant. Standard errors are clustered at the bank-time level and are in parentheses. \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 10:** Testing whether bank-level supply shocks are serially correlated

dep. var $\bar{\alpha}_{bt}$	(1)	(2)	(3)
$\bar{\alpha}_{bt-1}$	-0.0883*** (0.0337)	-0.0909** (0.0363)	-0.0889** (0.0420)
$\bar{\alpha}_{bt-2}$		0.0184 (0.0292)	-0.00572 (0.0294)
$\bar{\alpha}_{bt-3}$			-0.0143 (0.0276)
$\bar{\alpha}_{bt-4}$			-0.0214 (0.0298)
Observations	1,894	1,758	1,545
R-squared	0.012	0.015	0.017

Note: This table tests for serial correlation in the average bank level supply shocks  $\bar{\alpha}_{bt}$ , which corresponds to the value of  $\hat{\alpha}_{ibt}$  averaged over all countries. All regressions include a constant and time fixed effects. Robust standard errors are in parentheses. \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

Table 11: Baseline results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
						1997-2003	2004-2012
dep. var. $\Delta X_{it}$							
shock <sub>it</sub>	0.0875*** (0.0331)	0.0878** (0.0350)	0.0888** (0.0351)				
shock <sub>it</sub> < p50				0.159** (0.0721)			
shock <sub>it</sub> ≥ p50				0.0602 (0.0401)			
shock smaller banks <sub>it</sub>					0.0943* (0.0531)	0.158** (0.0760)	-0.00318 (0.0669)
shock top 5 banks <sub>it</sub>					0.0858** (0.0418)	-0.0250 (0.101)	0.109* (0.0580)
pop. growth <sub>it</sub>		-1.527** (0.607)	-2.299*** (0.703)	-2.289*** (0.656)	-2.298*** (0.721)	-2.282 (1.716)	-2.625*** (0.838)
GDP growth <sub>it</sub>		-0.0418 (0.0748)	-0.0859 (0.0699)	-0.0838 (0.0796)	-0.0857 (0.0696)	-0.0321 (0.128)	-0.142 (0.103)
USD xrate growth <sub>it</sub>		-0.199*** (0.0701)	-0.252*** (0.0783)	-0.252*** (0.0863)	-0.252*** (0.0726)	-0.164* (0.0978)	-0.459*** (0.163)
non-U.S. import growth <sub>it</sub>		0.370*** (0.0519)	0.361*** (0.0536)	0.361*** (0.0519)	0.361*** (0.0504)	0.333*** (0.0699)	0.386*** (0.0740)
Country FE	no	no	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes	yes
Observations	5,357	4,904	4,904	4,904	4,904	2,105	2,799
R-squared	0.049	0.068	0.102	0.102	0.102	0.112	0.113

Note: This table reports our baseline results on the causal impact of trade finance supply shocks on U.S. export growth. The dependent variable is the growth rate of U.S. exports to country  $i$  at time  $t$ .  $shock_{it}$  is the constructed country-level trade finance supply shock. Above and below median shocks are constructed using only bank-level shocks above or below the quarterly median. Column (5) includes country-level shocks that are obtained by aggregating separately the bank-level shocks of the top 5 banks and the remaining banks. Column (6) includes all years prior to 2004. Column (7) includes the years from 2004 onward. All regressions include a constant. Standard errors are bootstrapped and are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 12:** Heterogeneous effects on export growth across countries and over time I

dep. var. $\Delta X_{it}$	(1) crisis	(2) no crisis	(3) all	(4) small entry	(5) large entry	(6) all	(7) small entry & crisis	(8) all
shock <sub>it</sub>	0.183*** (0.0668)	0.0611 (0.0409)	0.0587 (0.0461) 0.123* (0.0744)	0.189*** (0.0620)	-0.00196 (0.0262)	0.0442 (0.0340)	0.332** (0.133)	0.00411 (0.0425) 0.139** (0.0681)
shock <sub>it</sub> × crisis dummy <sub>t</sub>								0.0906 (0.0567)
shock <sub>it</sub> × small entry dummy <sub>i</sub>						0.0800 (0.0526)		-2.320*** (0.0699)
pop. growth <sub>it</sub>	-3.785 (2.664)	-1.915** (0.767)	-2.292*** (0.690)	-2.925*** (0.812)	0.169 (0.838)	-2.325*** (0.698)	-4.139 (4.437)	-0.252*** (0.0775)
GDP growth <sub>it</sub>	-0.0675 (0.278)	-0.114 (0.0803)	-0.0823 (0.0774)	-0.198 (0.129)	-0.0443 (0.0745)	-0.0879 (0.0774)	-0.137 (0.424)	-0.0842 (0.0775)
USD xrate growth <sub>it</sub>	-0.547 (0.375)	-0.212*** (0.0798)	-0.253*** (0.0799)	-0.413** (0.188)	-0.165** (0.0734)	-0.251*** (0.0668)	-1.017 (0.670)	-0.252*** (0.0764)
non-U.S. import growth <sub>it</sub>	0.503*** (0.182)	0.332*** (0.0515)	0.359*** (0.0487)	0.381*** (0.0759)	0.377*** (0.0478)	0.362*** (0.0509)	0.507 (0.343)	0.360*** (0.0466)
Observations	701	4,203	4,904	2,203	2,701	4,904	320	4,904
R-squared	0.212	0.099	0.103	0.082	0.228	0.103	0.175	0.103

Note: This table tests for differences in the effect of trade finance supply shocks on U.S. export growth over time and across countries. The dependent variable is the growth rate of U.S. exports to country  $i$  at time  $t$ .  $shock_{it}$  is the constructed country-level trade finance supply shock. Column (1) only includes observations during the crisis period from 2007 q3 to 2009 q2. Column (2) excludes these. Column (3) includes a crisis dummy variable takes a value of one during the crisis period. Column (4) is based on a sample of small U.S. export destinations with log U.S. exports below the sample median. Column (5) includes only large export destinations. Column (6) is based on the full sample, where small entry dummy<sub>i</sub> takes a value of 1 if log U.S. exports to a destination are below the sample median. Column (7) includes observations for small export destinations during the crisis period. Column (8) uses the full sample and includes both dummies. All regressions include a constant, time- and country-fixed effects. Standard errors are bootstrapped and are in parentheses. \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 13:** Heterogeneous effects on export growth across countries and over time II

	(1)	(2)	(3)
dep. var. $\Delta X_{it}$	small # banks	large # banks	all
shock <sub>it</sub>	0.186*** (0.0558)	-0.0346 (0.0314)	0.0915* (0.0477)
shock <sub>it</sub> × crisis dummy <sub>t</sub>			0.129* (0.0752)
shock <sub>it</sub> × large # banks dummy <sub>it</sub>			-0.0927** (0.0464)
large # banks dummy <sub>it</sub>			0.00649 (0.0152)
pop. growth <sub>it</sub>	-2.702*** (0.833)	-0.708 (0.982)	-2.321*** (0.700)
GDP growth <sub>it</sub>	-0.115 (0.138)	-0.0736 (0.0631)	-0.0872 (0.0793)
USD xrate growth <sub>it</sub>	-0.333* (0.201)	-0.226*** (0.0644)	-0.254*** (0.0835)
non-U.S. import growth <sub>it</sub>	0.414*** (0.0792)	0.324*** (0.0449)	0.359*** (0.0489)
Observations	2,390	2,514	4,904
R-squared	0.088	0.234	0.103

Note: This table tests for differences in the effect of trade finance supply shocks on U.S. export growth across countries and over time. The dependent variable is the growth rate of U.S. exports to country  $i$  at time  $t$ .  $shock_{it}$  is the constructed country-level trade finance supply shock. Column (1) only includes destinations that were served by less than five U.S. banks in quarter  $t - 1$ . Column (2) includes destinations with at least five active banks. Column (3) is based on the full sample, where large # banks dummy<sub>it</sub> is a variable that takes the value of 1 if at least five U.S. banks had positive trade finance claims in country  $i$  at time  $t - 1$  and zero otherwise. All regressions include a constant, time- and country-fixed effects. Standard errors are bootstrapped and are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 14:** Robustness I: Placebo regressions and other checks

	(1)	(2)	(3)	(4)
dep. var. $\Delta X_{it}$	lagged shock	EU15 export growth	entry time trend	including zeros
shock $_{it}$		0.00189 (0.0290)	0.0858** (0.0372)	0.0987* (0.0508)
shock $_{it-4}$	-0.00155 (0.0374)			
pop. growth $_{it}$	-2.413*** (0.666)	-0.502 (0.575)	-2.325*** (0.610)	-2.292*** (0.715)
non-U.S. import growth $_{it}$	0.355*** (0.0533)		0.359*** (0.0424)	0.360*** (0.0462)
GDP growth $_{it}$	-0.0781 (0.0843)	-0.101** (0.0402)	-0.0963 (0.0864)	-0.0637 (0.0763)
USD xrate growth $_{it}$	-0.218** (0.0899)	-0.356*** (0.0486)	-0.255** (0.103)	-0.239*** (0.0897)
Observations	4,440	4,916	4,904	4,939
R-squared	0.112	0.168	0.114	0.100

Note: This table shows the results of two placebo regressions and a robustness check. In column (1), the country-level shock is lagged by one year. In column (2), the dependent variable is growth in exports by EU15 countries to destination  $i$ . The regression in column (3) allows for country-specific time trends. In column (4), the bank-level shocks that are used to compute the variable  $shock_{ct}$  are obtained from estimating a modified version of equation 1, namely:  $2 \frac{t f_{bcd} - t f_{bct-1}}{t f_{bcd} + t f_{bct-1}} = \alpha_{bt} + \beta_{ct} + \epsilon_{bct}$ . All regressions include a constant, time and country fixed effects. Standard errors are bootstrapped and are in parentheses. \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 15: Robustness II: Evidence against specialization**

Industries	(1) Bank A		(2) Bank B		(3) Bank C		(4) Bank D		(5) Bank E		(6) Bank F		(7) Bank G		(8) Bank H		(9) Bank I		(10) Bank J	
	Shares $\sigma^k$	Shocks $\theta^k$																		
Chemicals & Allied Industries	-0.0551 (0.201)	-0.531 (0.358)	-0.164 (0.127)	-0.0998 (0.237)	-0.0784 (0.0998)	0.129 (0.271)	-0.306*** (0.110)	0.268 (0.552)	0.429** (0.187)	-1.123 (0.889)										
Food Stuff	1.167 (0.836)	-0.361 (0.300)	0.0419 (0.405)	0.508** (0.217)	-0.339 (0.250)	-0.117 (0.207)	0.108 (0.392)	-0.338 (0.382)	-0.206 (0.579)	-0.0328 (0.361)										
Footwear & Headgear	0.651 (2.643)	0.0928 (0.280)	1.943 (9.510)	0.108 (0.290)	0.815 (1.129)	-0.332 (0.272)	-4.837 (3.150)	-0.647 (0.533)	-8.426 (5.785)	0.291 (0.917)										
Machinery & Electrical	0.398*** (0.109)	-0.302 (0.329)	-0.0959 (0.115)	0.316 (0.685)	0.112 (0.0817)	-0.322 (0.338)	-0.173 (0.105)	0.558 (0.412)	-0.464*** (0.133)	0.682 (0.550)										
Metals	-0.827*** (0.253)	0.0392 (0.267)	-0.222 (0.355)	-0.0827 (0.287)	-0.140 (0.195)	-0.0124 (0.232)	0.204 (0.306)	0.412 (0.438)	0.334 (0.386)	-0.0514 (0.702)										
Mineral Products	-0.261** (0.113)	0.143 (0.198)	0.238** (0.104)	-0.220 (0.154)	0.127 (0.0947)	0.232 (0.139)	0.298*** (0.105)	0.00886 (0.235)	0.139 (0.151)	0.383 (0.370)										
Miscellaneous	0.804*** (0.270)	-0.0955 (0.410)	0.285** (0.137)	0.466 (0.431)	0.206 (0.223)	-0.272 (0.289)	-0.344 (0.278)	0.268 (0.505)	-0.476* (0.258)	-0.150 (0.293)										
Other	0.180 (0.125)	-0.302 (0.193)	0.0269 (0.185)	0.203 (0.294)	-0.0662 (0.0671)	-0.215 (0.259)	0.0941 (0.104)	-0.561* (0.288)	0.143 (0.0880)	0.104 (0.635)										
Plastics & Rubbers	-0.288 (0.619)	0.0105 (0.192)	-1.092** (0.426)	-0.475 (0.312)	-0.134 (0.276)	0.248 (0.198)	-0.502 (0.463)	0.0750 (0.351)	-0.0113 (0.495)	0.00409 (0.369)										
Raw Hides, Skins, Leather, & Furs	1.155 (1.458)	0.0731 (0.178)	2.127 (1.529)	0.0223 (0.356)	0.763 (2.490)	0.212 (0.293)	-0.488 (1.969)	0.274 (0.513)	-1.403 (1.868)	0.633 (0.617)										
Stone & Glass	-0.540*** (0.176)	0.366 (0.220)	-0.0383 (0.162)	0.0329 (0.289)	0.213 (0.274)	-0.0663 (0.175)	0.0998 (0.168)	-0.118 (0.384)	0.384 (0.245)	-0.424 (0.322)										
Textiles	0.0387 (0.255)	0.0944 (0.455)	-0.525* (0.306)	-0.120 (0.394)	-0.571* (0.317)	0.171 (0.325)	-0.353** (0.174)	0.449 (0.519)	0.249 (0.224)	-1.057 (0.930)										
Transportation	-0.206** (0.0870)	0.218 (0.247)	-0.0478 (0.0621)	0.114 (0.577)	-0.0663 (0.0547)	0.00502 (0.219)	0.0230 (0.0661)	-0.101 (0.364)	0.0635 (0.105)	0.907 (0.764)										
Wood & Wood Products	1.844** (0.805)	-0.341 (0.400)	-0.358 (1.163)	0.0522 (0.315)	-0.347 (0.745)	-0.680** (0.307)	-0.370 (0.805)	-0.204 (0.718)	0.341 (1.214)	-1.307 (1.239)										

Note: This table reports a robustness check that tests for the specialization of banks in industries. The regressions presented are for the top 5 trade finance suppliers, denoted Bank A to Bank E. In odd columns, a bank's share in the total trade finance claims of country  $i$  at time  $t$  is regressed on the share of industry  $k$  in total exports to country  $i$  at time  $t$ . These regressions include country-fixed effects and standard errors are clustered at the country level. In even columns, the average bank-level shock  $\bar{\alpha}_t^b$  of bank  $b$  is regressed on the estimated industry shock  $\hat{\alpha}_t^k$  associated with industry  $k$ . Robust standard errors are in parentheses. All regressions include a constant. \*, \*\*, and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 16:** Robustness III: Excluding regions or small countries

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
dep. var. $\Delta X_{it}$	all	crisis	no crisis	large entry	large entry & crisis	small entry	small entry & crisis
shock <sub>it</sub>	0.0529** (0.0263)	0.116** (0.0578)	0.0330 (0.0288)	-0.00474 (0.0215)	0.0141 (0.0464)	0.0806* (0.0461)	0.183 (0.122)
pop. growth <sub>it</sub>	-1.487** (0.596)	-3.808 (2.536)	-1.849** (0.791)	0.404 (0.720)	-1.182 (1.585)	-2.880*** (0.931)	-2.931 (3.790)
GDP growth <sub>it</sub>	-0.0357 (0.0730)	-0.0709 (0.274)	-0.107 (0.0827)	0.0195 (0.0725)	0.00253 (0.153)	-0.195 (0.123)	-0.146 (0.415)
USD xrate growth <sub>it</sub>	-0.197*** (0.0698)	-0.542 (0.330)	-0.209** (0.0836)	-0.0639 (0.0604)	-0.0397 (0.198)	-0.477*** (0.169)	-0.953* (0.495)
non-U.S. import growth <sub>it</sub>	0.370*** (0.0524)	0.503** (0.199)	0.332*** (0.0532)	0.394*** (0.0476)	0.475*** (0.0789)	0.327*** (0.0693)	0.381 (0.268)
Observations	4,902	701	4,201	2,782	382	2,514	355
R-squared	0.068	0.208	0.099	0.202	0.417	0.077	0.155

Note: Columns (1) to (3) of the table report results of the following robustness check: the bank-level shocks that are used to compute the country-level shocks that apply to country  $i$  are estimated without information from any country in country  $i$ 's the region. Columns (4) to (7) show the results when only large export destinations are used to estimate bank-level shocks. In column (4) only large destinations are included in the sample. In column (5), only large countries and quarters from 2007 q3 to 2009 q2 are included. Column (6) is based on a sample with small export destinations only. Columns (7) shows the effect for small export markets and the crisis period. All regressions include a constant, time- and country-fixed effects. Standard errors are bootstrapped and are in parentheses. \*, \*\*, and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 17:** Robustness IV: Excluding countries with similar industry trade structure

	(1)	(2)	(3)
dep. var. $\Delta X_{it}$	all	crisis	no crisis
shock $_{it}$	0.0677** (0.0307)	0.126** (0.0544)	0.0515 (0.0341)
pop. growth $_{it}$	-2.285*** (0.683)	-3.724 (2.653)	-1.909** (0.775)
GDP growth $_{it}$	-0.0852 (0.0717)	-0.0577 (0.253)	-0.115 (0.0839)
USD xrate growth $_{it}$	-0.250*** (0.0731)	-0.534* (0.279)	-0.210** (0.0849)
non-U.S. import growth $_{it}$	0.362*** (0.0532)	0.506*** (0.171)	0.332*** (0.0534)
Observations	4,903	701	4,202
R-squared	0.102	0.209	0.099

Note: This table reports results of a robustness check that exploits information on the similarity across destinations in terms of the goods they import from the U.S. The bank-level shocks that are used to compute the country-level shocks  $shock_{it}$  for each country  $i$  are obtained by excluding those 30 countries that are closest to country  $i$  in terms of the industry structure of their U.S. imports. All regressions include a constant, time- and country-fixed effects. Standard errors are bootstrapped and are in parentheses. \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 18:** Robustness V: Alternative specification of banks' market shares

	(1)	(2)	(3)	(4)	(5)
dep. var. $\Delta X_{it}$	1q lag	3q lag	4q lag	4q rolling av.	last year's av
shock $_{it}$	0.0785** (0.0317)	0.0655** (0.0321)	0.0709* (0.0406)	0.0708* (0.0363)	0.0739** (0.0335)
pop. growth $_{it}$	-2.288*** (0.694)	-2.295*** (0.686)	-2.282*** (0.639)	-2.267*** (0.720)	-2.289*** (0.728)
non-U.S. import growth $_{it}$	0.360*** (0.0532)	0.360*** (0.0488)	0.360*** (0.0479)	0.361*** (0.0553)	0.360*** (0.0534)
GDP growth $_{it}$	-0.0862 (0.0785)	-0.0845 (0.0724)	-0.0862 (0.0762)	-0.0868 (0.0715)	-0.0861 (0.0805)
USD xrate growth $_{it}$	-0.254*** (0.0811)	-0.251*** (0.0715)	-0.251*** (0.0725)	-0.250*** (0.0802)	-0.254*** (0.0755)
Observations	4,904	4,904	4,904	4,904	4,904
R-squared	0.102	0.101	0.101	0.101	0.102

Note: This table shows that results are robust to the way country-level shocks are constructed. In each column, the variable shock $_{it}$  is constructed using different market shares  $\phi_{ibt}$ . The dependent variable is the growth rate of U.S. exports to country  $i$  at time  $t$ . shock $_{it}$  is the constructed country-level trade finance supply shock. In column (1), the country-level shocks are constructed using one quarter lagged bank market shares. In column (2), three quarters lagged bank market shares are used. In column (3), bank market shares are lagged by four quarters. In column (4), market shares are averaged over the last four quarters. In column (5), a banks' average market share in the last year is computed and this market share is applied to construct all shocks in the next year. All regressions include a constant, time and country fixed effects. Standard errors are bootstrapped and are in parentheses. \*, \*\* and \*\*\* denote significance at the 10%, 5% and 1% level.

**Table 19: Quantifications**

Region	Shock to Bank A	Shock to Bank B	Shock to all banks
	all times (1)	all times (2)	crisis times (3)
East Asia and Pacific	-0.469%	-1.257%	-3.64%
Europe and Central Asia	-0.536%	-1.382%	-3.89%
South Asia	-0.411%	-1.861 %	-3.74%
Sub-Saharan Africa	-2.86%	-0.375 %	-3.97%

Note: Columns (1) and (2) of the table show the effect on export growth in different world regions if two different large banks in the U.S. were to reduce its supply of trade finance by a value of -0.426, which corresponds to the 10th percentile of the bank-level shock distribution. To calculate these numbers, the shock coefficient in column (3) of table 11 is used. Column (3) displays the effect on export growth if all U.S. banks were subject to a moderate shock of -0.245, which corresponds to the 25th percentile of the bank-level shock distribution during a crisis episode. The column is based on the coefficients displayed in column (8) of table 12, that is, the effect of a reduction in the supply of trade finance is allowed to differ across destinations with different sizes.