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

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

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

## Abstract

This study provides evidence that shocks to the supply of trade finance have a causal effect on U.S. exports. The identification strategy exploits variation in the importance of banks as providers of letters of credit across countries. The larger a U.S. bank's share of the trade finance market in a country is, the larger should be the effect on exports to that country if the bank reduces its supply of letters of credit. We find that supply shocks have quantitatively significant effects on export growth. A shock of one standard deviation to a country's supply of trade finance decreases exports, on average, by 2 percentage points. The effect is much larger for exports to small and risky destinations and in times when aggregate uncertainty is high. Our results imply that global banks affect export patterns and suggest that trade finance played a role in the Great Trade Collapse.

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

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

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# 1 Introduction

During the Great Recession, world trade relative to global GDP collapsed by 20 percent. Since then, there has been much debate about whether and to what extent trade finance played a magnifying role in the Great Trade Collapse.<sup>1</sup> The hypothesis is that worsening financial conditions have a greater effect on trade than on domestic sales because trade takes longer (working capital channel) and is riskier (risk channel).<sup>2</sup>

While previous research has focused more on the working capital channel,<sup>3</sup> this paper provides evidence that the risk channel is highly relevant for aggregate trade flows.<sup>4</sup> Specifically, we show that a reduction in the supply of letters of credit, an instrument to reduce risk in international trade, has a large, causal effect on exports both in crisis and non-crisis times. We also document, for the first time, that trade finance not only affects the levels of trade but also trade patterns. Because letters of credit are destination specific and banks are specialized in providing them to certain markets, an idiosyncratic bank shock has asymmetric effects across export destinations. In addition, supply shocks have stronger effects on exports to smaller and riskier countries and in times when aggregate uncertainty is high. These new results reveal that it is key to distinguish between the risk and the working capital channel.<sup>5</sup> They suggest a role for trade finance in explaining the trade collapse in 2008/2009, in particular with respect to trade in small and high risk countries.

This paper also contributes to other strands of the literature. Related to the literature on granularity (see Gabaix (2011)), we find that shocks to individual banks can have quan-

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<sup>1</sup>Eaton et al. (2011), Bems et al. (2010), and Levchenko et al. (2010) argue that most of the drop in trade in 2008/2009 is explained by changes in demand and compositional effects. In contrast, using data from Japan that covers an earlier crisis, Amiti and Weinstein (2011) find that bank shocks reduce international trade more than domestic sales. Ahn et al. (2011) analyze the behavior of export and import prices during the recent financial crisis, also arguing for a role of trade finance.

<sup>2</sup>Ahn (2010) and Schmidt-Eisenlohr (2013) develop theoretical models to show this.

<sup>3</sup>Amity and Weinstein (2011) provide reduced-form evidence that financial shocks affect exports through both channels. Their data does, however, not allow them to distinguish directly between the two. Paravisini et al. (2011) use loan data to study the working capital channel. Del Prete and Federico (2012) only find evidence for the working capital channel.

<sup>4</sup>Works that also stress the risk channel are van der Veer (forthcoming), Ahn (2013), and Hale et al. (2013), which are discussed in detail below.

<sup>5</sup>In contrast to this study, Paravisini et al. (2011), who analyze the working capital channel, find uniform effects of bank shocks across export destinations.

titatively important effects on exports in the aggregate. Moreover, letters of credit represent a new channel through which financial conditions affect the real economy and through which global banks transmit shocks across borders.<sup>6</sup>

Information on trade finance employed in this paper is from the FFIEC 009 Foreign Exposure Reports that all large U.S. banks are required to file.<sup>7</sup> We observe banks' trade finance claims, which reflect mostly letters of credit 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 the year 2012. Thus, the trade finance activities captured in our data are sizable relative to trade.

Based on this data, we estimate time-varying trade finance supply shocks. This is an improvement compared to existing studies of the effect of financial shocks on trade, which rely on instrumental variable approaches and analyze the effect of shocks only during crises periods. We largely follow the methodology in Greenstone and Mas (2012) and Amiti and Weinstein (2013) 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 correspond to idiosyncratic bank-level supply shocks. To address potential reverse causality 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 deposits and loans, which is evidence that, among others, the estimated bank-time-fixed effects capture idiosyncrasies in bank health.

Idiosyncratic bank shocks 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 a letter of credit. A letter of credit is a means to reduce the risk of a trade, which works as follows: The importer asks a bank in her country to issue a letter of credit. This letter is sent to the exporter. It guarantees that the issuing bank will pay the agreed contract value

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<sup>6</sup>There is a growing literature on the real effects of financial crisis. See, for example, Chodorow-Reich (forthcoming), Greenstone and Mas (2012), Khwaja and Mian (2008), and Rosengren and Peek (2000). In addition, several papers investigate how global banks transmit shocks across borders. See, for example, Cetorelli and Goldberg (2012) and Kalemli-Ozcan et al. (2012).

<sup>7</sup>This data was first used in Niepmann and Schmidt-Eisenlohr (2013).

to the exporter if a set of conditions is fulfilled.<sup>8</sup> In addition, a bank in the country of the exporter can confirm the letter of credit, whereby the confirming bank commits to paying in case the issuing bank defaults.<sup>9</sup> The nature of this transaction implies significant fixed costs so that the business is highly concentrated with only a few large banks. Moreover, information about counter-parties is acquired over time, which is not easily transferable. As long as firms cannot switch to another bank and are not willing to trade without a letter of credit or adjust quantities because trade costs are higher under alternative payment forms, a reduction in the provision of letters of credit by a single bank has an effect on exports.

The identification strategy pursued in this paper exploits variation in the importance of banks as providers of letters of credit across countries. The same reduction in the supply of letters of credit 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-specific shocks to trade finance explain 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 by 2 percentage points. We show that negative shocks have larger effects than positive shocks in line with Amiti and Weinstein (2011). Moreover, effects are present at all times: even when the recent crisis period is excluded from the sample, the effect of supply shocks is significant. We also document that shocks to the five biggest trade finance banks account for most of the aggregate effects.

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 are correlated with both export growth and supply shocks. Given our methodology, there remain

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<sup>8</sup>For example, the issuing bank may promise to pay upon receipt of shipping documents.

<sup>9</sup>Many development banks provide trade finance and confirm letters of credit in developing and emerging countries. For example, the International Finance Corporation (IFC), an entity of the World Bank Group, runs a program to confirm letters of credit. See IFC (2012) for details.

two concerns why the assumption might not hold. First, one might be worried that the estimated bank-level supply shocks are not entirely purged of demand effects. To address this issue we do the following exercise. We regress the estimated bank shocks on observed loan and deposit growth and use the predicted values of the regression to compute country-level shocks. Based on this method, only variation in bank shocks enters the regression that can be explained by balance sheet items and should be orthogonal to the demand for trade finance. The results are unchanged when the alternative shocks are used.

The second, remaining issue is related to potential endogeneity of banks' market shares: if banks that exhibit positive shocks in period  $t$  were to increase their market shares in period  $t - 2$  in export destinations with positive deviations from trend growth in period  $t$ , then the identification assumption would be violated. We show that bank-level shocks are serially uncorrelated, that results are unchanged when we use different lags of banks' market shares and that market shares are persistent. These three findings together rule out 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. Because of the high concentration of the business, a reduction that corresponds to the 10th percentile of the shock distribution leads to a 0.9 percentage point decline in total U.S. exports. This illustrates that the behavior of a single bank can have a considerable effect in the aggregate. In this regard, this paper relates to Gabaix (2011) who shows that idiosyncratic shocks can have aggregate effects if firms are sufficiently large.

Another key result of this paper is that banks affect export patterns. Because banks specialize in confirming and issuing letters of credit in certain markets, a reduction in the supply of letters of credit by a single bank has asymmetric effects across export destinations. 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 a country-level shock of the same size has heterogeneous effects across export destinations. Exports to riskier destinations decline more when banks reduce

their supply of letters of credit. Also exports to smaller markets are more affected. This is likely because firms use letters of credit more intensively and are less willing to trade without them when exporting to riskier markets. At the same time, it is more difficult for firms to obtain a letter of credit from another bank in smaller markets, where fewer banks are active.

Paravisini et al. (2011), 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 letter of credit channel matters. A reduction in the supply of bank guarantees has a different effect on trade than a reduction in the supply of general loans. First, working capital needs are independent of destination country risk, whereas country risk determines whether an exporter demands a letter of credit. Moreover, working capital loans are fungible and firms can internally reallocate available funds. Letters of credit, in contrast, are destination specific and can only be obtained from a small number of banks.

Our empirical strategy does not allow us to quantify the effect of aggregate letter of credit supply shocks. However, our results strongly suggest that trade finance played a magnifying role in the Great Trade Collapse. First, the effect of supply shocks is present at all times and effects can be large. Second, letter of credit supply shocks are correlated with bank balance sheet items, in particular loan growth, and balance sheets deteriorated during the crisis.<sup>10</sup> Finally, the effect of supply shocks is largest in times of high uncertainty, which we proxy by the CBOE Volatility Index (VIX).<sup>11</sup> Our results imply that, when uncertainty is higher, which is also when letters of credit are used more extensively in international trade (see Niepmann and Schmidt-Eisenlohr (2013)), the effect of supply shocks is larger. The VIX reached its highest level on records in the first quarter of 2009. Therefore, while demand effects may explain a large part of the collapse in trade in 2008/2009, the letter of credit channel may also be quantitatively relevant, in particular for trade in small and risky countries.

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<sup>10</sup>See, e.g., Santos (2011), Chodorow-Reich (forthcoming), and Cornett et al. (2011).

<sup>11</sup>The VIX measures the expected volatility of the U.S. stock market over the next 30 days.



**Literature** A few papers study the role of financial shocks for international trade. Using Japanese matched bank-firm data from 1990-2010, 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 can establish a general link between banks and trade, they cannot test for heterogeneous effects of shocks across export destinations and cannot directly distinguish between different transmission channels due to data limitations. Indirect evidence for the risk channel is provided: exports of firms that have affiliates drop less than exports of stand-alone firms.

Paravisini et al. (2011) use matched bank-firm data from Peru to analyze the effect of credit supply shocks during the financial crisis, that is, they study the working capital channel and do not capture the letter of credit channel. The authors find that credit shocks reduce exports. As discussed above, effects do not differ across export destinations.

Del Prete and Federico (2012) use Italian matched bank-firm data that contains information on general loans, trade-related loans and guarantees but does not have information on trade by source or destination country. They find that trade is only affected by changes in the supply of general loans and not by changes in the supply of trade specific loans and guarantees. As our paper shows, the risk and the size of a destination country are of first-order importance for the letter of credit 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 evidence that bank guarantees matter.

There are three papers that also focus on the risk channel. Ahn (2013) analyzes the effect of bank balance sheet shocks on the provision of letters of credit in 2008/2009 in Columbia. Similar to this paper, he finds that bank balance sheet items predict variation in bank-level letter of credit supply. He does not test for the effect of supply shocks on 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. 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.

Finally, by identifying one specific channel through which financial conditions affect trade patterns, our paper is also related to Beck (2003) and Manova (2013) who show how financial development can generate a comparative advantage in trade.

The paper is structured as follows. Section 2 and 3 give background information on bank 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 letter of credit supply shocks. Section 7 relates our results to the debate on the Great Trade Collapse. Section 8 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 it can 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 does 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 letters of credit. Figure 1 illustrates how they work. A bank in the importing country issues a letter of credit, which is sent to the exporter. The letter of credit guarantees that the issuing bank pays the agreed contract value to the exporter if a set of conditions is fulfilled. These conditions typically include delivering a collection of documents to the bank, e.g. shipping documents that confirm the arrival of the goods in the

destination country. A letter of credit therefore 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 only gets paid after confirmation of delivery. It differs as the risk that the exporter has to bear is reduced by the guarantee of the bank.<sup>12</sup>

Typically, a bank in the exporting country is also involved in the letter of credit transaction. Because there is still a risk that the issuing bank defaults on its obligation, the exporter can ask a bank in her country to confirm the letter of credit. The confirming bank thereby agrees to pay the exporter if the issuing bank defaults. Under third party verifiability, the commitment problems that arise under open account and cash-in-advance are fully resolved.

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, letters of credit are widely used in international trade and are employed to a much smaller extent for domestic sales.<sup>13</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 (2012) present details on the market structure for the U.S. and Italy, respectively. In the year 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. There are only 10 Italian banks that extend guarantees.

The high concentration is likely due to high fixed costs. When banks issue or confirm letters of credit in support of exports, they need to have contacts to firms or banks in the importing country as well as knowledge of their credit- and trustworthiness. The business is relationship intensive in the sense that information is acquired over time that is not easily

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<sup>12</sup>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 a letter of credit are therefore higher. See Schmidt-Eisenlohr (2013), Antràs and Foley (2011) and Hoefele et al. (2013) for a more detailed discussion of the three payment forms.

<sup>13</sup>In addition, working capital needs are typically higher in international trade than for domestic sales. 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 (2013) for example, who finds that changes in interest rates affect trade more between countries that are further away from each other.

transferable. Banks also need to be familiar with the local market and the legal environment. Niepmann and Schmidt-Eisenlohr (2013) present evidence that fixed costs, in fact, play an important role and that only larger banks are able to cover them. They find a pecking order: smaller markets are, on average, served by larger banks.

Due to the high concentration of the market and the presence of information asymmetries, it should be difficult for firms to get a letter of credit from another bank when the confirming or the issuing bank is hit by a shock and cannot provide the service. 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>14</sup> As a consequence, the price of insurance should increase more with destination country risk than the price of letters of credit, and insurance may be unavailable in the most risky destinations. If a letter of credit cannot be obtained and trade insurance is very costly or cannot be bought either, importers and exporters may not be willing to trade. Then a reduction in the supply of letters of credit has an effect on trade.<sup>15</sup>

### 3 Data Description

The data on trade finance used in this paper is from the Country Exposure Report (FFIEC 009). U.S. banks that have more than \$30 million in total foreign assets are required to file this report and have to provide, country by country, information on their trade finance related claims with maturity one year and under. Claims are reported on a consolidated basis, that is, they also include the loans and guarantees extended by the foreign affiliates of U.S. banks.

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<sup>14</sup>When issuing or confirming a letter of credit, 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 letters of credit but have no reason to buy trade credit insurance.

<sup>15</sup>Note that there is an effect on trade even if all alternative contracts are available to a firm. It follows from revealed preferences that whenever letters of credit are used, other payment forms generate weakly lower profits. Hence, a reduction in the supply of letters of credit 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.

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 have on foreign parties is collected. Loans to U.S. residents and guarantees that back the obligations of U.S. parties are not recorded. Based on the reporting instructions, several trade-finance instruments can be included in the data that either support U.S. exports, U.S. imports or third-party trade as summarized in table 1. Niepmann and Schmidt-Eisenlohr (2013) provide a detailed discussion and exploration of the data. Their analysis indicates that letters of credit that support U.S. exports constitute, by far, the largest part of the observed trade finance volumes. This is followed by working capital loans to foreign exporters through U.S. bank affiliates abroad. Loans to foreign importers as well as loans in support of trade with other countries could also be included in the data but do not seem to represent a sizable share of the measured bank activities.

Transaction values and reported claims are related in the following way: Suppose that a U.S. bank confirms a letter of credit that is 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 that correspond to the transaction value of the letter of credit. The value of the letter of credit is, in turn, determined by the value of the goods that the Brazilian firm buys from the U.S exporter. 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 foreign exposure report on a consolidated basis, reports the contract value as claims vis-à-vis Brazil.

The trade finance data comes at a quarterly frequency. Our sample covers the period from the first quarter in 1997 to the second quarter in 2012.<sup>16</sup> As the average maturity of a confirmed letter of credit is 70 days (see ICC (2013)), the stock of claims at the end of a

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<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 onwards, 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.

quarter is highly correlated with the flow of exports in that quarter, so comparing growth in quarterly stocks with growth in quarterly trade flows makes sense. The data on U.S. trade in goods used in this paper is from the IMF Directions of Trade Statistics.

Figure 2 depicts the evolution of U.S. exports and banks' trade finance claims over time, as shown in Niepmann and Schmidt-Eisenlohr (2013).<sup>17</sup> Trade finance claims peaked in 1997/1998 during the Asian crisis and again during the financial crisis in 2007-2009.<sup>18</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. 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% of U.S. exports.

As Niepmann and Schmidt-Eisenlohr (2013) document, the use of letters of credit and trade finance varies substantially across destination countries. Figure 5 displays the average trade finance intensity of the top 35 countries from the first quarter in 2006 to the second quarter in 2012, defined as the ratio of banks' trade finance claims to U.S. exports. Countries with high levels of default risk and a large distance from the U.S. exhibit particularly high trade finance intensities. Systematic variation in the use of letters of credit across export destinations is one reason why the effect of trade finance supply shocks may be asymmetric across countries. We explore asymmetries in section 5.

## 4 Empirical Approach

### 4.1 Estimating trade finance supply shocks

In this section, we discuss our 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 letters of credit. Because we have information on the trade finance claims of U.S. banks by destination country that varies over time, we

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<sup>17</sup>The claims of one bank are excluded from the aggregates as this bank changed its trade finance business fundamentally in the reporting period.

<sup>18</sup>Evidence from Italy and IMF surveys also suggests that trade finance expanded during the recent financial crisis. See Del Prete and Federico (2012) and Asmundson et al. (2011).

can estimate time-varying idiosyncratic bank-level supply shocks directly from the data.<sup>19</sup> Following Greenstone and Mas (2012) and Amiti and Weinstein (2013), we estimate the following regression to disentangle supply shocks from demand shocks:<sup>20</sup>

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

$t f_{bct}$  corresponds to the trade finance claims of bank  $b$  in country  $c$  at time  $t$ . Trade finance growth rates are regressed on bank-time-fixed effects  $\alpha_{bt}$  and on country-time-fixed effects  $\beta_{ct}$ . The obtained bank-time-fixed effects correspond to the idiosyncratic bank shocks. By construction, they are independent of country-time specific factors that are related to the demand for trade finance and that affect all banks in the sample in the same way. To address the concern that bank shocks might pick up demand effects, bank shocks are estimated for each country separately: the bank shock  $\alpha_{ibt}$  for country  $i$  is obtained by estimating equation 1 without including observations of country  $i$ .  $\alpha_{ibt}$  therefore reflects growth in trade finance claims by bank  $b$  in period  $t$  based on changes in claims in all countries except country  $i$ .

The estimated supply shocks  $\alpha_{ibt}$  are used to construct country-specific supply shocks as follows:

$$\Delta t f_{it} = \sum_b^B \phi_{ibt-2} \alpha_{ibt}, \quad (2)$$

where  $\phi_{ibt-2} = \frac{t f_{ibt-2}}{\sum_b^B t f_{ibt-2}}$ . 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 one- or three-period lagged market shares are used instead. The effect of country supply shocks on exports is estimated based on the following equation:

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

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<sup>19</sup>This is different from previous works on the effect of finance on trade, which rely on proxy variables to identify shocks. Amiti and Weinstein (2011) use banks' market to book values. Paravisini et al. (2011), Del Prete and Federico (2012) and Ahn (2013) exploit variation in banks' funding exposures.

<sup>20</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.

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

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. Given that the bank shocks are by construction orthogonal to export growth, our identification assumption  $E((\sum_b^B \phi_{ibt-2} \alpha_{ibt}) \Delta X_{it}) = 0$  can only be violated if the lagged bank market shares  $\phi_{ibt-2}$  are endogenous to the bank shocks and export growth. In section 5.3, we provide evidence against the hypothesis that banks specialize in certain industries and that banks sort systematically into export markets. This basically resolves all remaining endogeneity concerns.

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 done when the bank shares  $\phi_{ibt-2}$  are calculated. If a bank acquired another bank in time  $t-2$ , we use the country share of the two banks added up to obtain the bank shares. Bank supply shocks are estimated on a sample where observations in the first and 99th percentiles of the trade finance growth rate distribution are deleted to mitigate the influence of outliers. In the export regression (equation 3), countries with a population below 250,000, offshore financial centers and the top and the bottom one percentile of the export growth rate distribution are excluded from the sample.<sup>21</sup>

## 4.2 Heterogeneity and persistence in banks' market shares

The empirical strategy in this paper requires that the importance of single banks is heterogeneous across destination markets. 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

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<sup>21</sup>If we include extreme growth rates, the shock coefficient  $\gamma$  becomes larger compared to the results reported in columns (1) to (3) of table 9 and is statistically significant at the 10 percent level. A list of countries designated as offshore financial centers can be found in the appendix.



shares were very volatile, then lagged values would not contain useful information about the degree to which idiosyncratic bank shocks affect different countries.

The upper panel of table 2 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 bank active in the trade finance business. 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).

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 3.<sup>22</sup> Two-period lagged values, which are used to construct country supply shocks, still explain around 77 percent of the variation.

A parallel exercise can be conducted for the number of banks  $n_{it}$  that are active in a given market. The lower panel in table 2 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 4 displays the results.

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<sup>22</sup>If we adjusted for M&As, then persistence would be even higher.

The two-quarter lagged number of active banks explains approximately 92 percent of the variation in this variable.

### 4.3 Validation of bank supply shocks

There are a total of 101 different banks in the sample for which we obtain trade finance supply shocks. In the third quarter of 1997, we obtain bank shocks for 52 different banks down to 15 banks in the second quarter of 2012. The declining number of banks is due to consolidation in the banking sector. In total, 35,919 time-country-varying bank shocks are observed over the sample period from 1997 q2 until 2012 q2.<sup>23</sup> Figure 4 shows the distribution of bank shocks, which exhibit significant variation and are centered around zero. Table 5 provides the corresponding summary statistics. Figure 5 displays the median bank shock over time. The dashed line represents the quarterly median of  $\alpha_{ibt}$ . The solid line is corrected for a common time effect.

To validate that the estimated bank shocks are reasonable, we check whether they are correlated with different balance sheet items.<sup>24</sup> To that end, we regress the mean bank shock  $\bar{\alpha}_{bt}$ , which corresponds to the value of  $\alpha_{ibt}$  averaged over all countries, on deposit growth and loan growth of bank  $b$  at time  $t$ . Results are displayed in table 6. All columns include time-fixed effects. Standard errors are clustered at the bank level. The results in column (1) indicate that the average bank shock is positively correlated with banks' deposit growth although the coefficient is not significant at standard significance levels. Column (2) shows that the bank shocks are also positively correlated with loan growth. In the regression in column (3), both deposit and loan growth are included as regressors. In this case, the coefficient on loan growth is statistically significant. The bank shock is larger, the larger a bank's loan growth is. This suggests that, among others, the estimated supply shocks capture idiosyncrasies in bank health.

Next, we 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

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<sup>23</sup>As the sample starts in the first quarter of 1997, growth rates can only be computed from the second quarter of 1997 onwards.

<sup>24</sup>Balance sheet information for banks in the sample comes from the Y9c and FFIEC 031 reports.

regression:

$$\Delta t f_{ibt} = \alpha_{ibt} + \xi_t + \xi_i(+\xi_{it}) + \eta_{ibt}. \quad (4)$$

$\Delta t f_{ibt}$  represents the growth rate of the claims of bank  $b$  in country  $i$  at time  $t$  observed in the data.  $\alpha_{ibt}$  is the 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 7. 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 countries have strong predictive power for the actual growth of trade finance claims of bank  $b$  in country  $i$  at time  $t$ .

Finally, we investigate whether bank supply shocks are serially correlated.<sup>25</sup> Table 8 displays results from a regression of the average bank shock  $\bar{\alpha}_{bt}$  on its lagged value and time-fixed effects. The regression in column (1) only includes the one-quarter lagged bank shock. In column (2), the two-quarter lagged shock is added as regressor. Column (3) includes one- to four-quarter lagged values of  $\bar{\alpha}_{bt}$ . In all three columns, the coefficients of the lagged bank shocks are always insignificant. Bank shocks are not serially correlated. Past realizations of the bank shock have no predictive power for the bank shock today.

## 4.4 Distribution of country supply shocks

In a next step, details on the computed country-level supply shocks  $\Delta t f_{it}$  are given. In total, we obtain country shocks for 159 different countries. The distribution of country supply shocks is displayed in figure 6. Given that banks' market shares vary substantially across countries, country shocks also show considerable variation. Table 5 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

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<sup>25</sup>We use the result of this exercise in section 5.3, in which we discuss our identification strategy and endogeneity concerns in detail.

that are correlated with export growth and trade finance supply shocks. Results do not change when country-fixed effects are left out, however, as we show in the next section. This is because supply shocks are randomly distributed across countries. To illustrate this, we plot, in figure 7, 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 implies 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 7 shows that this is the case and thereby indicates that there is no correlation between banks' market shares  $\phi_{ibt}$  and the estimated bank-level shocks  $\alpha_{ibt}$ .

## 5 Results

### 5.1 Baseline results

Table 9 presents the baseline regression results obtained from estimating equation 3. In column (1), export growth is regressed on trade finance supply shocks and time-fixed effects. The estimated effect of supply shocks is positive and significant at a 3.8 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), country-fixed effects are added, which neither affects the magnitude nor the significance of the coefficient. This confirms that trade finance supply shocks are not correlated with time-invariant country characteristics as discussed in the previous section. In column (3), the growth of U.S. imports from country  $i$  in period  $t$  is added to control for general developments in the destination country. Again, the estimated coefficient is practically unchanged.

In columns (4) to (6), results are shown for negative and positive shocks separately. Country-level shocks are computed using either positive or negative bank-level shocks when aggregating shocks up to the country level. The results indicate that negative and positive shocks have asymmetric effects. Only the point estimate of the negative shock is statistically

significant at a 10 percent level. In addition, it is larger than the coefficient of the positive shock.<sup>26</sup> This is as expected and confirms findings in Amiti and Weinstein (2011). Because a reduction in the supply of letters of credit typically requires cutting from existing customers whereas additional supply is more fungible, negative shocks should have a stronger impact.

In columns (7) and (8), results are shown for 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. Even when excluding the crisis period, the effect of supply shocks on export growth is significant at a 10 percent level in column (8) of table 10. This is evidence that the identification of the effect does not rely on the crisis period and that idiosyncratic bank shocks affect exports at all times.

A simple quantification shows that the estimated effect on export growth is large. Based on the coefficient of 0.0572 displayed in column (1) of table 9, a country supply shock of one standard deviation increases export growth by 2 percentage points. This corresponds to about 7 percent of one standard deviation of export growth in the sample. As a reference, figure 8 shows the distribution of export growth rates. We discuss the magnitude of the effect in more detail in section 6.

In a next step, we compute country-level supply shocks from the bank shocks of the five biggest trade finance suppliers and the remaining banks separately and rerun the baseline regression. Table 10 shows the results. Only the coefficient on the shocks to the top five banks is significant, now at a 2 percent significance level. Moreover, the  $R^2$  is barely affected when shocks of smaller banks are included. This suggests that, in particular, the top players in the business affect export growth.

## 5.2 Heterogeneous effects across export destinations

In this section, we test whether the effect of supply shocks on exports is heterogeneous across destinations. To start with, we include an interaction term between the shock and country risk in the baseline regression. Our measure of country risk is from the Economist Intelligence

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<sup>26</sup>The estimates are not significantly different from each other, however.

Unit and is available from 2000 onwards. It is a composite index that measures sovereign, exchange rate and banking risk in a country. Column (1) of table 11 shows the results. The interaction term is positive and significant at a 5 percent significance level. This indicates that exports to destinations with higher risk are more affected by idiosyncratic bank shocks. Column (2) tests for a non-linear relationship between the magnitude of the effect and risk. The regression controls both for a simple interaction term as well as for an interaction between the shock and risk squared. Both interactions are significant at a 10 percent significance level. The upper panel of figure 9 plots the estimated effect of supply shocks as a quadratic function of country risk. The graph shows that the relationship between the size of the shock and risk is u-shaped. The effect is particularly strong for high risk countries: the shock coefficient exceeds the value of 0.1 for countries with risk levels above 60, which corresponds to the risk rating of Nicaragua in the year 2012 for example. Hence, the effect is double as large for high risk countries than what the coefficient in column (1) of table 9 suggests. Heterogeneity in the effect across countries is quantitatively important.

The effect of supply shocks on export growth also varies considerably across export destinations of different sizes. The regression that underlies column (3) of table 11 includes an interaction term between the shock and the one-quarter lagged number of banks that have positive trade finance claims in a given market, which is an indirect measure of the size of an export market.<sup>27</sup> The negative and significant coefficient on the interaction term indicates that the shock has a smaller effect on export growth in countries in which a larger number of U.S. banks are active. In column (4), the size of the export market is measured by the log of the average U.S. exports to a destination country from 1997 until 2012. As before, this variable is interacted with the shock. As expected, the coefficient of the interaction term is negative, confirming that shocks have larger effects on export growth in smaller markets. The lower panel of figure 9 displays the estimated relationship between the magnitude of the effect of supply shocks and market size based on the coefficients in column (4) of table 11. The point estimates range from roughly 0.03 to slightly above 0.2. The same qualitative results hold when market size is proxied by the log of nominal GDP instead.

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<sup>27</sup>Niepmann and Schmidt-Eisenlohr (2013) show that the number of banks increases with exports to a market.

To further explore the role of market size, we split the sample into two. The regression in column (5) of table 11 includes only countries with below median values of log average U.S. exports. Column (6) includes all countries to which log average U.S. exports are above the sample median. The effect of trade finance supply shocks on export growth is only significant for smaller markets. Moreover, the point estimate is much larger, taking a value of 0.117. Hence the coefficient doubles as large destination markets are excluded. At the same time, the coefficient on the shock is insignificant and declines considerably when only large countries are included, down to 0.006. These results clearly indicate that exports to small countries with high levels of risk are particularly affected if banks contract their supply of letters of credit.

This is easy to rationalize. Only few U.S. banks issue and confirm letters of credit in small and high risk destinations. If one of the banks that is active in those markets reduces its supply, it is especially difficult for trading partners to find an alternative. Moreover, selling to small and high risk destinations without a letters of credit might not be profitable for the exporter: trade insurance is less likely to be available or very costly and the implicit cost for a firm of conducting the transaction without a guarantee may be high. Effects may also be increasing in risk because letters of credit are used more intensively in high risk countries in general (see Niepmann and Schmidt-Eisenlohr (2013)).<sup>28</sup>

### 5.3 Identification and robustness

In this section, several robustness checks are presented. First, we address the concern that our estimated bank supply shocks might not be entirely purged of demand effects. To that end, we instrument bank-level shocks using balance sheet items. All results remain the same. Second, we show that the results are also 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 serially uncorrelated,

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<sup>28</sup>An alternative explanation is that banks may not cut trade finance symmetrically across export destinations. We do not find any evidence, however, that this is indeed the case. When we estimate equation 4 including interaction terms between country variables and the estimated bank shocks, coefficients on the interaction terms are always insignificant.

this practically eliminates any concern that there could be an endogeneity problem due to sorting of banks into markets. Finally, we show that our results also hold when additional time-varying country controls are included in the regression.

One may be concerned that the estimated supply shocks are still endogenous to demand effects. If banks were fully specialized in one particular industry and there was a shock to demand or production in this industry, then the estimated bank shock might pick up industry effects. Under full 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 developments.<sup>29</sup> To account for this issue, we do the following exercise: As shown in column (3) of table 6, the growth rate in loans of bank  $b$  at time  $t$  and its deposit growth can explain the average supply shock of bank  $b$  at time  $t$ . We can therefore use the predicted values of the regression instead of the originally estimated shocks to construct country-level shocks and reestimate the baseline regression. Given that trade finance claims only account for a small share of a bank's balance sheet, deposit growth and loan growth are very unlikely to be correlated with the demand for trade finance so that endogeneity is not a concern.<sup>30</sup>

Column (1) of table 12 shows the results. The estimated shock coefficient is 0.0704. It is significant at a 12 percent significance level and has roughly the same size as before. The effect of the shock becomes highly significant once heterogeneity across countries is taken into account. Columns (2) to (5) include the interaction terms of table 11. The estimated coefficient of the interaction term between the shock and country risk in column (2) is qualitatively the same, suggesting, as before, that exports to countries with higher risk are more affected when banks financial conditions worsen. The presence of a non-linear effect of risk is also supported (see column (3)). Moreover, columns (4) and (5), which include an interaction term between the shock and the number of banks active in a given market and an interaction term between the shock and log average exports, respectively, confirm that

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<sup>29</sup>While we do not observe who the banks' clients are that obtain trade financing, it is very unlikely that banks are only active in a very small number of industries. There are only a few key banks while there are many more firms and industries. Moreover, banks diversify risks and hence should seek to spread trade financing over different industries and firms.

<sup>30</sup>In the first quarter of 2012, a bank's total trade finance claims corresponded, on average, to 0.161 percent of its total assets. See Niepmann and Schmidt-Eisenlohr (2013) for more details.



larger markets with a larger number of trade finance suppliers are less affected.

The previous discussion addresses concerns that the idiosyncratic bank shocks that we obtain could be endogenous to export growth. Any remaining correlation between country-level shocks and export growth rates that is not due to the letter of credit channel must thus come from endogeneity in banks' market shares. Our 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) and (2) of table 13, banks' market shares are lagged by one or three quarters, respectively, when computing the country shocks  $\Delta tf_{ct}$ , in contrast to the two-quarter lags used in the baseline specification. The effect of supply shocks on export growth remains significant at a 5 percent level throughout. Given these results, our identification strategy could only be violated if banks that anticipate to grow in period  $t$  sort in period  $t - 1$ ,  $t - 2$  and  $t - 3$ , 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 serially uncorrelated. That is, past bank supply shock have no predictive power for supply shocks today. The fact that all three lags work is therefore inconsistent with systematic sorting of banks period by period.

As a final robustness check, we add several time-varying country variables to the baseline regression. Column (3) of table 13 controls for GDP growth, population growth, the change in the USD exchange rate as well as for growth in non-U.S. imports of country  $i$ . Results are unchanged: the shock coefficient is significant as before, now at a 2.5 percent significance level.

## 6 Quantifying the Effect of Supply Shocks

To explore, in greater detail, the magnitude of the effects 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 -0.53). Using this bank's market shares in each destination country

in the fourth quarter of 2011 and export values of the first and second quarter in 2012, the predicted aggregate effect on export growth is calculated as follows:

$$\Delta X_t = \frac{\sum_{c=1}^N (\gamma(-0.53)\phi_{c,t-2}X_{ct-1})}{X_t} \quad (5)$$

We set  $\gamma$  equal to 0.0572, which corresponds to the estimated coefficient in column (1) of table 9. The calculations predict that such a trade finance supply shock would reduce aggregate U.S. export growth by around 0.9 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. Table 14 shows the results. Whereas exports in South Asia would fall by -0.9 percentage points if bank 1 was hit by the shock, the same relative reduction in trade finance by bank 2 would reduce exports in this region by -0.3 percentage points. In contrast, this shock would affect U.S. exports to East Asia and the Pacific more evenly. This example illustrates that banks, through their global operations, affect export patterns. The same bank shock affects countries differentially, depending on how important the bank is for the provision of letters of credit in each export market.

## 7 Trade Finance and the Great Recession

There is an ongoing debate concerning the extent to which trade finance contributed to the Great Trade Collapse in 2008/2009. While our estimation strategy does not allow us to identify aggregate supply shocks, the evidence presented in this paper suggests that trade finance played a magnifying role. First, we find that shocks to the supply of letters of credit have a causal effect on exports at all times. Second, the effects can be large, and single banks are large enough to affect aggregate outcomes so that shocks to individual banks can significantly harm exports. Third, the idiosyncratic bank shocks that we obtain are correlated

with bank balance sheets, in particular with loan growth. Balance sheets deteriorated during the crisis.<sup>31</sup> Together, these findings strongly suggest that the letter of credit channel was a contributor to the trade collapse in 2008/2009.

In the following discussion, we present additional evidence that trade finance played a magnifying role in the Great Trade Collapse. We find that the effect of bank shocks on export growth is stronger in times when the CBOE Volatility Index (VIX) is higher. The VIX measures the expected volatility of the U.S. stock market over the next 30 days and is often used as a proxy for aggregate uncertainty and risk aversion. We employ quarterly averages of the VIX in the regressions displayed in table ?? . Column (1) reports the results of a regression of export growth on the shock, an interaction term between the shock and the VIX, as well as time- and country-fixed effects. The interaction term is positive but not statistically significant. However, once we take into account that the effect of shocks on export growth varies with the size of the export market, we find strong evidence that the strength of the effect of supply shocks varies systematically with the VIX.

In column (2), a triple interaction between the shock, log average exports and the VIX is included in the regression together with all relevant pairwise interactions. To ease the interpretation, we depict the estimated effect of supply shocks as a function of log average exports in figure 10. The diamonds represent results evaluated at the minimum VIX level and the circles show effects for the maximum VIX level. The figure illustrates that supply shocks have much larger effects in times when the VIX is high. These periods typically coincide with crisis periods. Figure 11 plots the log of the quarterly average of the VIX over time, which reached its maximum of 3.78 in the first quarter of 2009 and its minimum of 2.43 in the first quarter of 2006. The estimated effect of supply shocks is around zero in tranquil times. However, in periods with high uncertainty, it is about 0.2 points larger.

The result that bank shocks have stronger effects when the VIX is high is likely due to the fact that letters of credit are used more in times of high uncertainty as found in Niepmann and Schmidt-Eisenlohr (2013). A larger share of exporters relies on letters of credit to settle international transactions when there is more aggregate risk so that supply constraints can

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<sup>31</sup>Moreover, in addition to the effects on exports through the letter of credit channel, there may have been additional effects through a reduction in the supply of working capital loans.

have more bite.

As documented previously, the effect of trade finance supply shocks is largest in small and risky countries. Hence, while demand effects may explain most of the drop in exports and imports in large, developed countries, the findings in this paper suggest that trade finance can explain a sizable drop in trade especially in risky, developing countries. Therefore, through the letter of credit channel, the crisis may have spilled over to exports and imports to and from countries that were not directly affected by the financial crisis.

## 8 Conclusions

Exploiting data on the trade finance claims of U.S. banks that varies 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 highlights the letter of credit channel. We show that shocks to the supply of letters of credit, a trade-specific financial instrument, have statistically and economically significant effects on exports. Unlike previous papers, we find that the effects of trade finance shocks are heterogeneous across destinations. Exports to countries that are riskier and smaller are more affected. At the same time, the same bank-level shock has an asymmetric effect on trade across destination countries because banks specialize in providing letters of credit to certain markets. These findings imply that banks have an impact on trade patterns and transmit shocks across borders.

As the quantifications show, the effect of supply shocks on aggregate U.S. exports can be large. Because the trade finance business is highly concentrated in a few big banks, a large negative shock to a single bank can reduce exports by up to 1 percentage point. Effects are particularly large when uncertainty is high as measured by the VIX. The VIX reached its peak in the first quarter of 2009, in the midst of the Great Recession. Therefore, the results presented in this paper suggest that trade finance has a role in explaining the Great Trade Collapse, in particular with respect to trade in small and risky countries.

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# Data Appendix

## Data sources

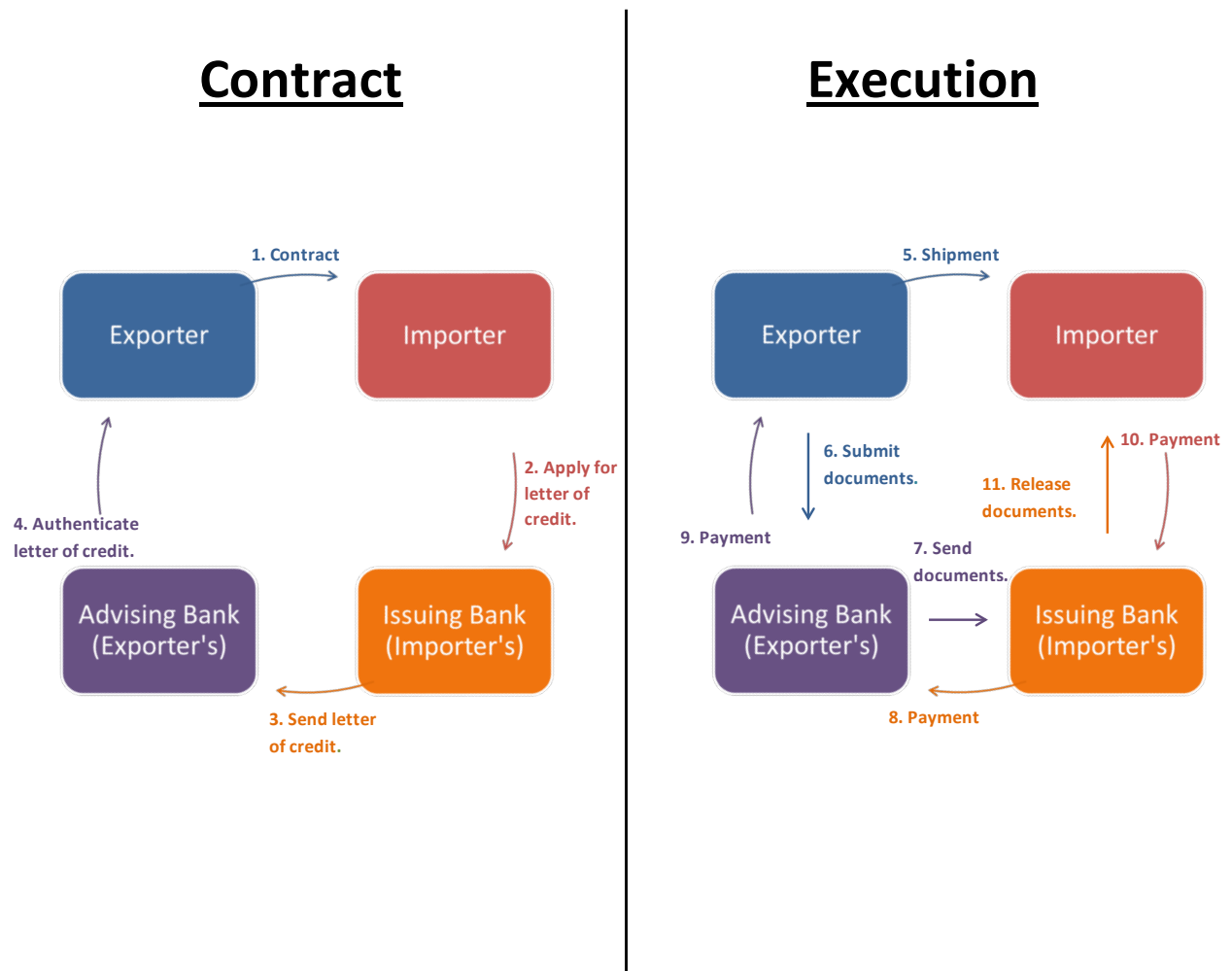
- Quarterly trade data is from the IMF's Directions of Trade Statistics.
- Balance sheet data is from the FFIEC031 or the Y9c reports. Where available, FFIEC031 information was aggregated up for each Bank Holding Company to match the FFIEC009 reporting level.
- Quarterly GDP was obtained from national statistical agencies via Haver Analytics' Data Link Express (DLX) Software.
- Annual population: World Development Indicators.
- EIU country risk: Quarterly index that combines banking, sovereign and currency risk, provided by the Economist Intelligence Unit, downloaded from Thomson Reuters Datastream.
- Exchange rates: International Financial Statistics, IMF.
- CBOE Volatility Index: Quarterly averages calculated from daily data downloaded from Bloomberg Terminal.

## List of countries

- Countries designated as offshore financial centers: Netherlands Antilles, Antigua and Barbados, Azerbaijan, Bahrain, Bahamas, Belize, Bermuda, Barbados, Cayman Islands, Cyprus, Dominica, Grenada, Hong Kong, Ireland, Jordan, Lebanon, Macao, Monaco, Maldives, Malta, Mauritius, Seychelles, Vanuatu, Samoa.



Figure 1: How a letter of credit works

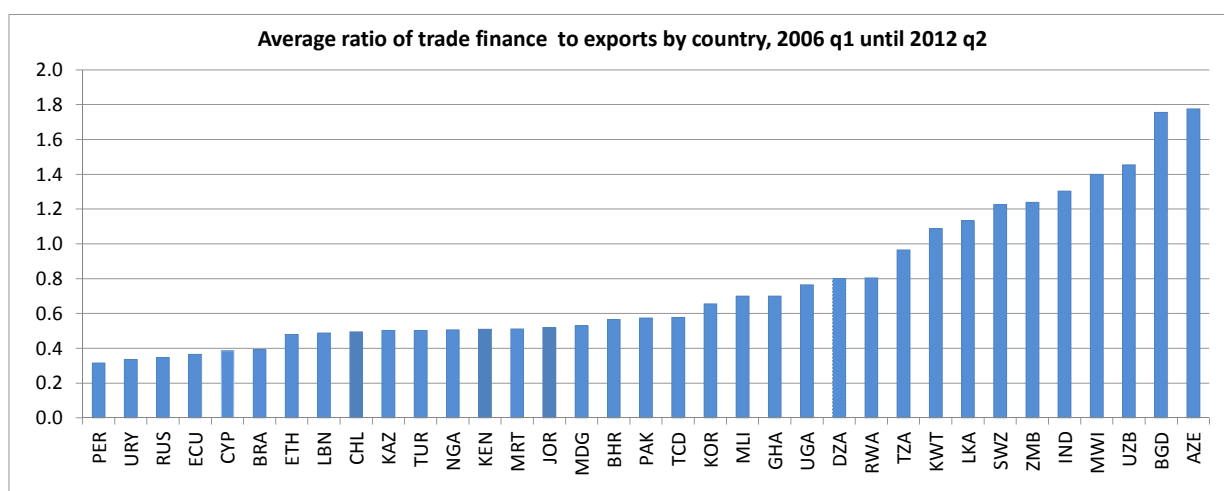


**Figure 2:** Evolution of aggregate trade finance claims and exports



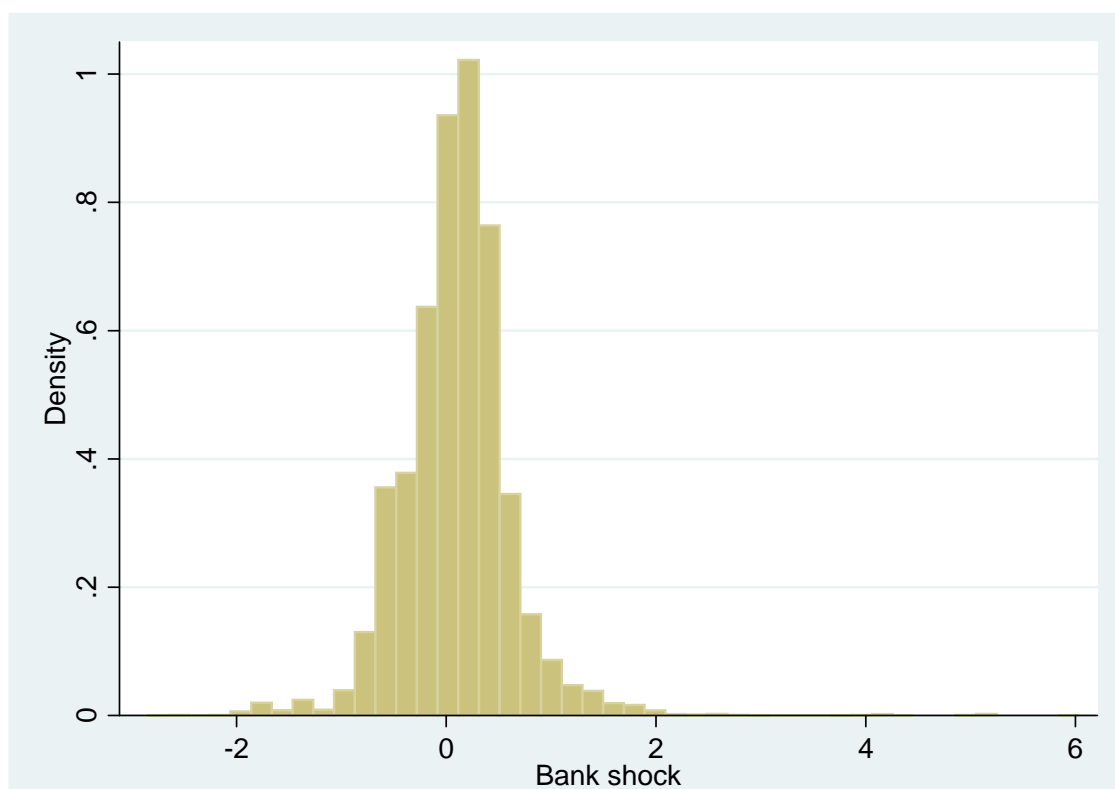
Note: The solid line in the graph shows the aggregate trade finance claims of all reporting U.S. banks over time. The years 1997-2000 exclude data from one large bank that changed its trade finance business fundamentally in the reporting period. The dashed line displays the evolution of aggregate U.S. exports in goods over time. Data sources: FFIEC 009 Report, IMF Directions of Trade Statistics.

**Figure 3:** Heterogeneity in the use of trade finance



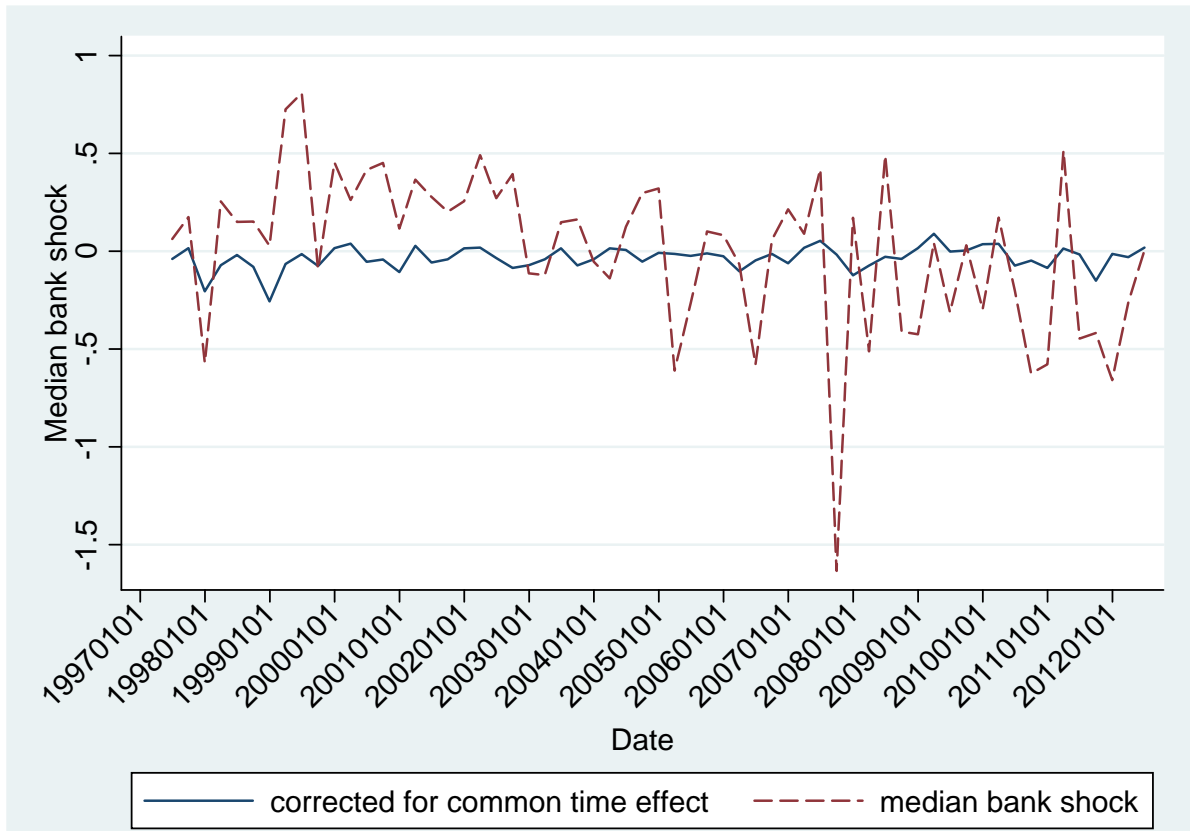
Note: The graph displays the average trade finance intensities of the top 35 countries from 2006 to 2012. A country's trade finance intensity is defined as the quarterly ratio of aggregate trade finance claims to total U.S. exports in goods. Offshore financial centers are excluded. Data sources: FFIEC 009 report, IMF Directions of Trade Statistics.

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



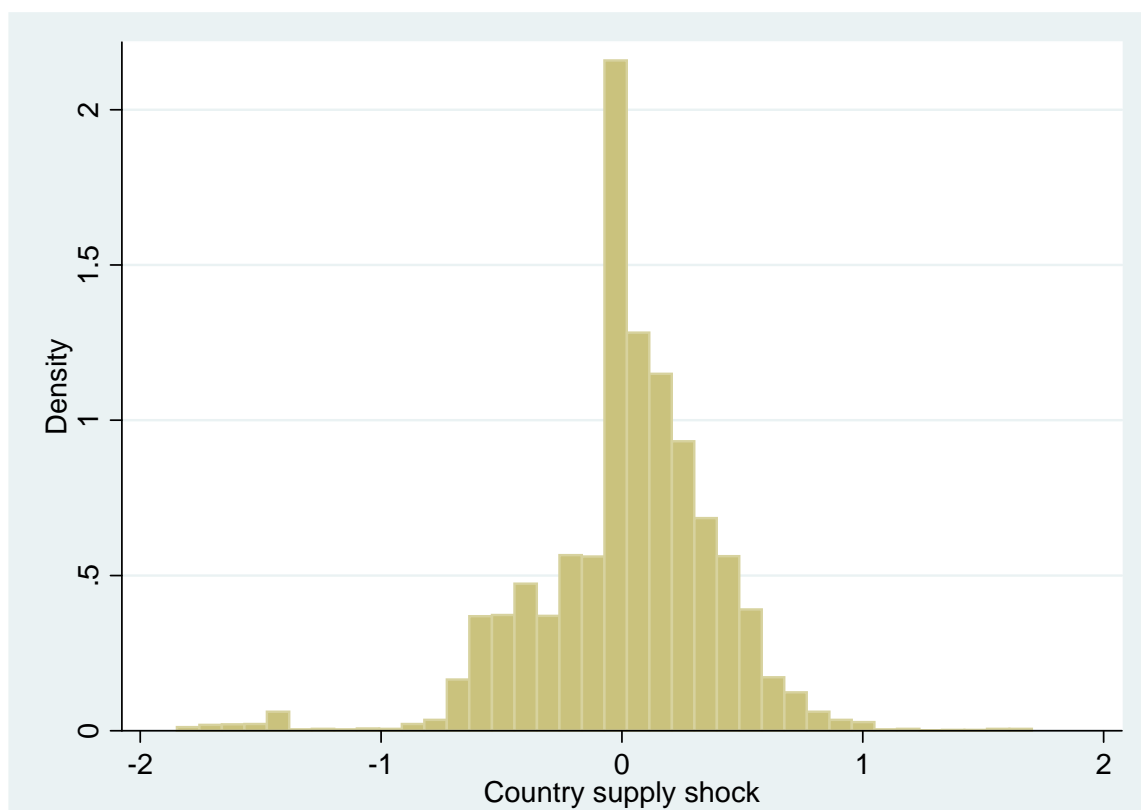
Note: The graph shows the histogram of the estimated bank-level shocks.

**Figure 5:** Median bank supply shock over time



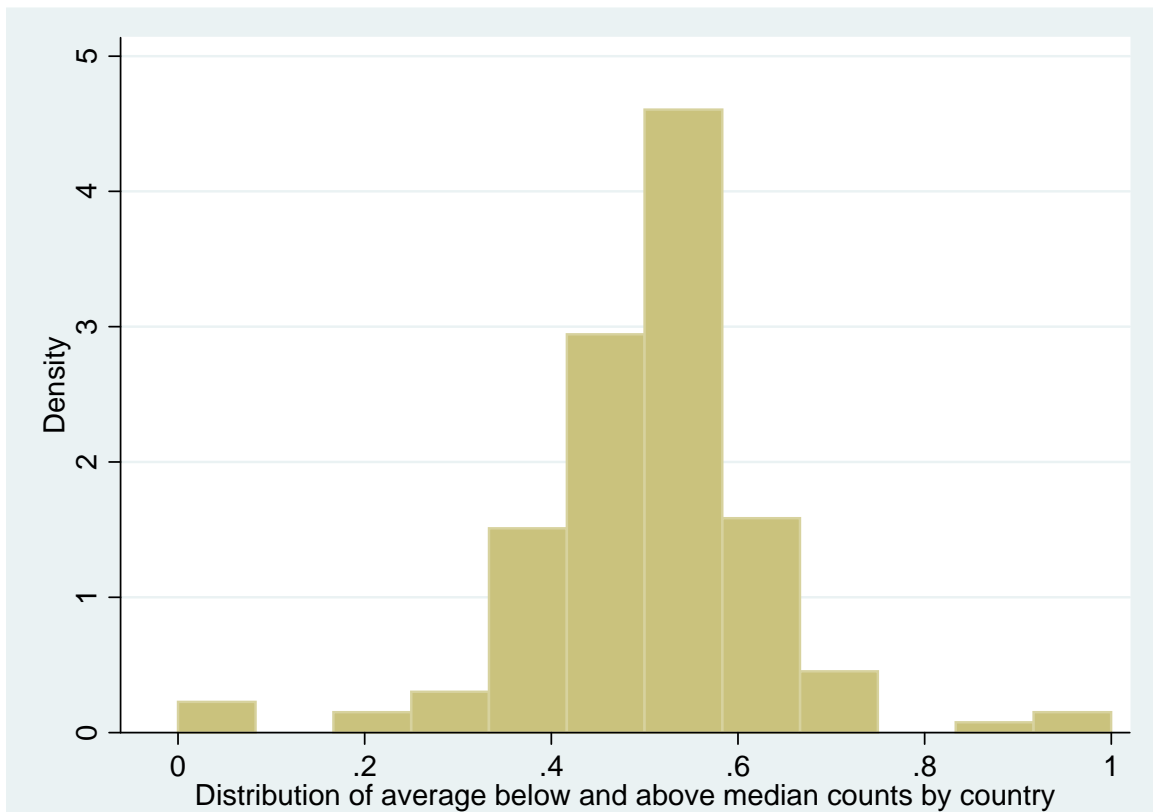
Note: The dotted line in the graph shows the median bank-level supply shock over time. The solid line displays the median supply shock when supply shocks are corrected for a common time trend.

**Figure 6:** Distribution of country supply shocks



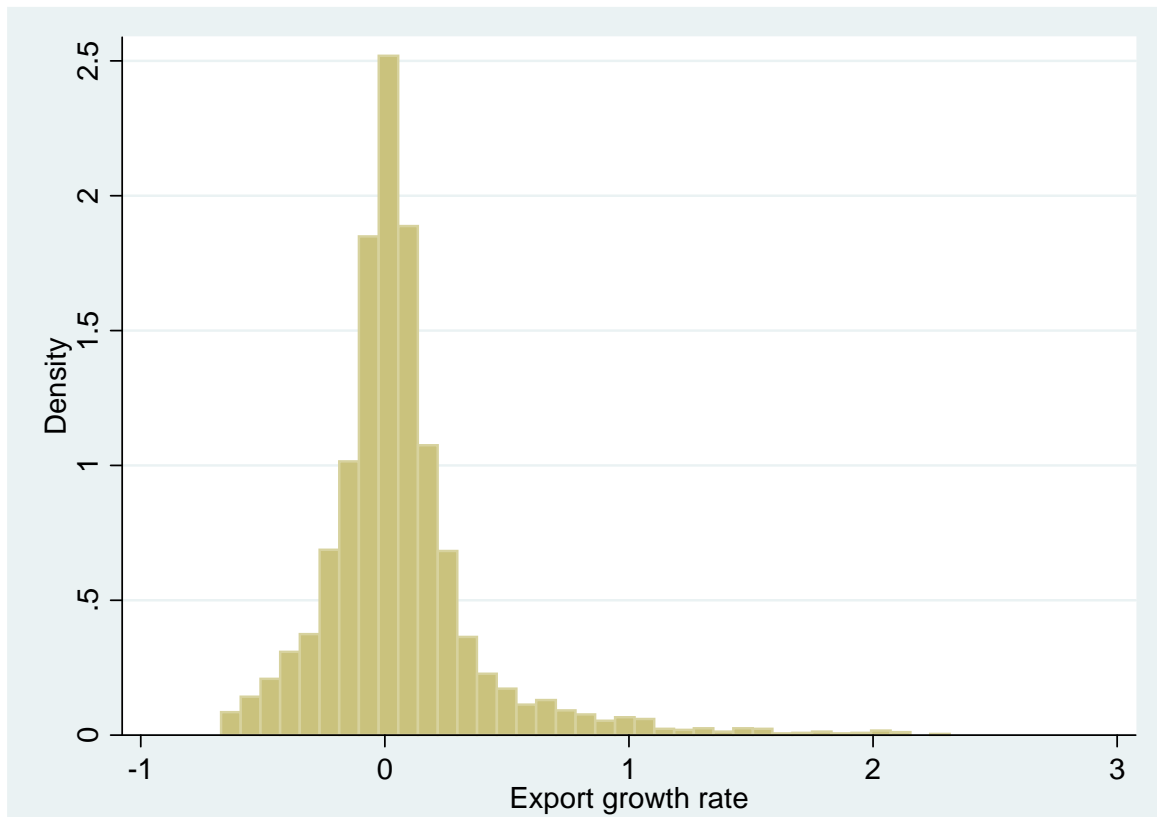
Note: The graph shows the histogram of the computed country-level shocks.

**Figure 7:** Evidence for random distribution of shocks across countries



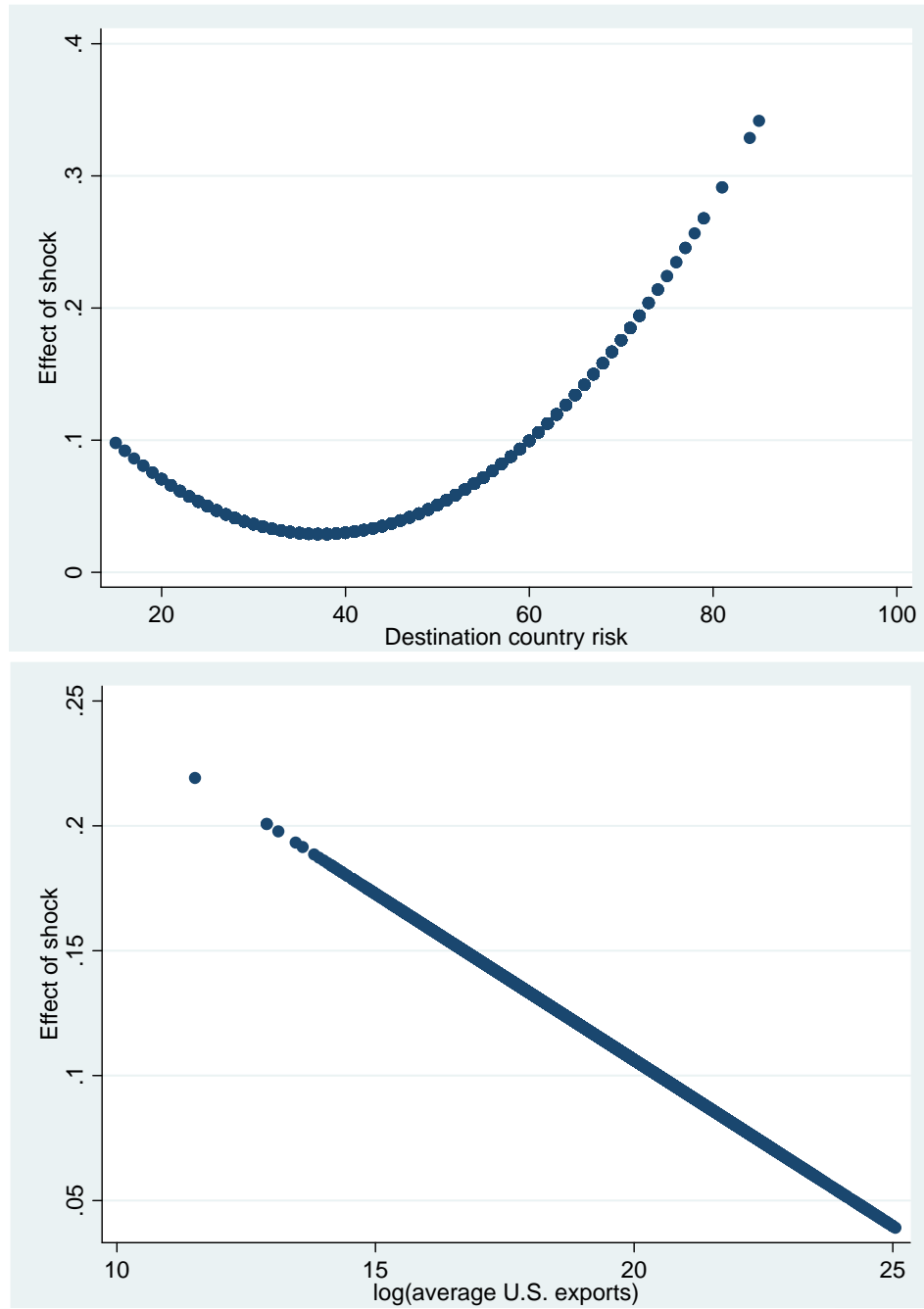
Note: The histogram shows the distribution of country means of a dummy variable that takes value 1 if country  $i$  is hit by an above median shock in period  $t$  and zero otherwise. If shocks are randomly distributed across countries, then the means should be distributed symmetrically around 0.5.

**Figure 8:** Distribution of export growth rates



Note: The graph shows the distribution of the quarterly growth rate of U.S. exports by destination country over the sample period from the first quarter in 1997 until the second quarter in 2012.

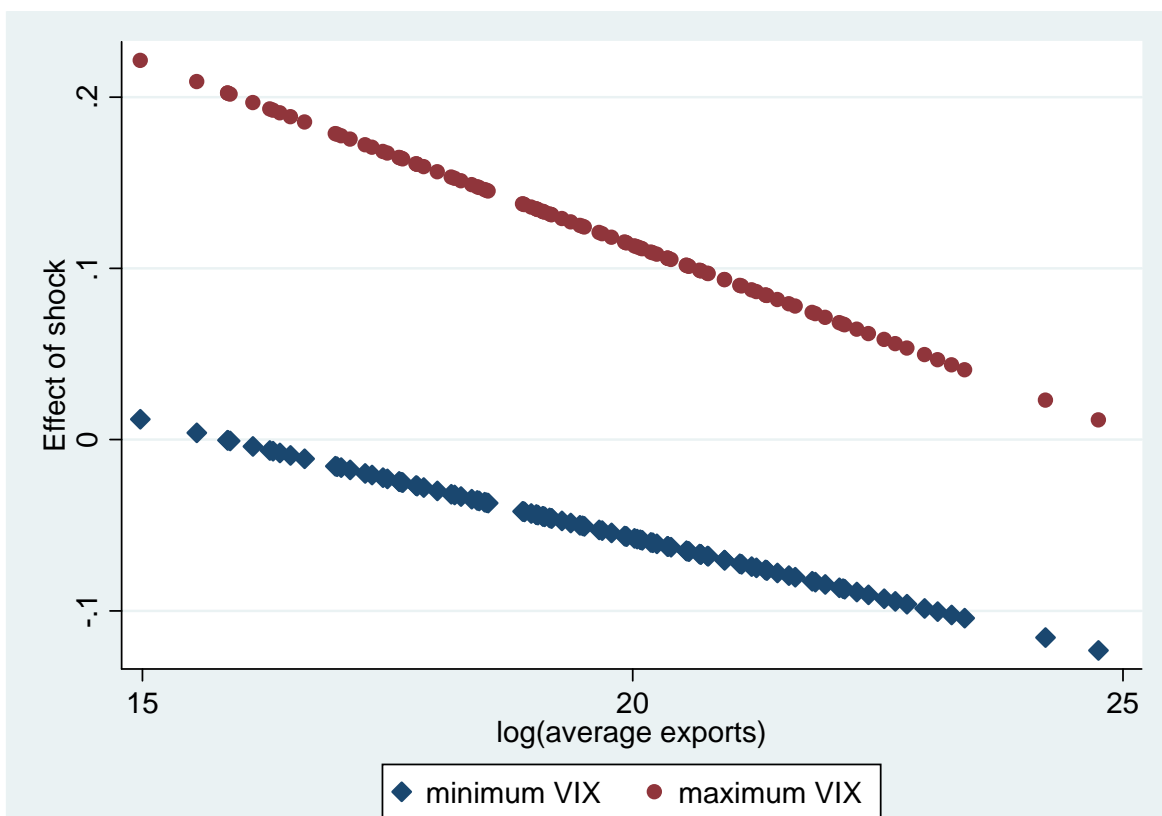
**Figure 9:** Heterogeneous effects of shocks across export destinations



Note: The upper panel of the figure shows the estimated effect of a country-level supply shock on export growth as a function of country risk. Country risk is measured by the EIU country risk index, which is a composite index of banking, sovereign and exchange rate risk. The lower panel displays the estimated effect of a country-level supply shock as a function of the size of the export market. The size of an export market is measured by the logarithm of the average U.S. exports to a country from the first quarter of 1997 to the second quarter of 2012.

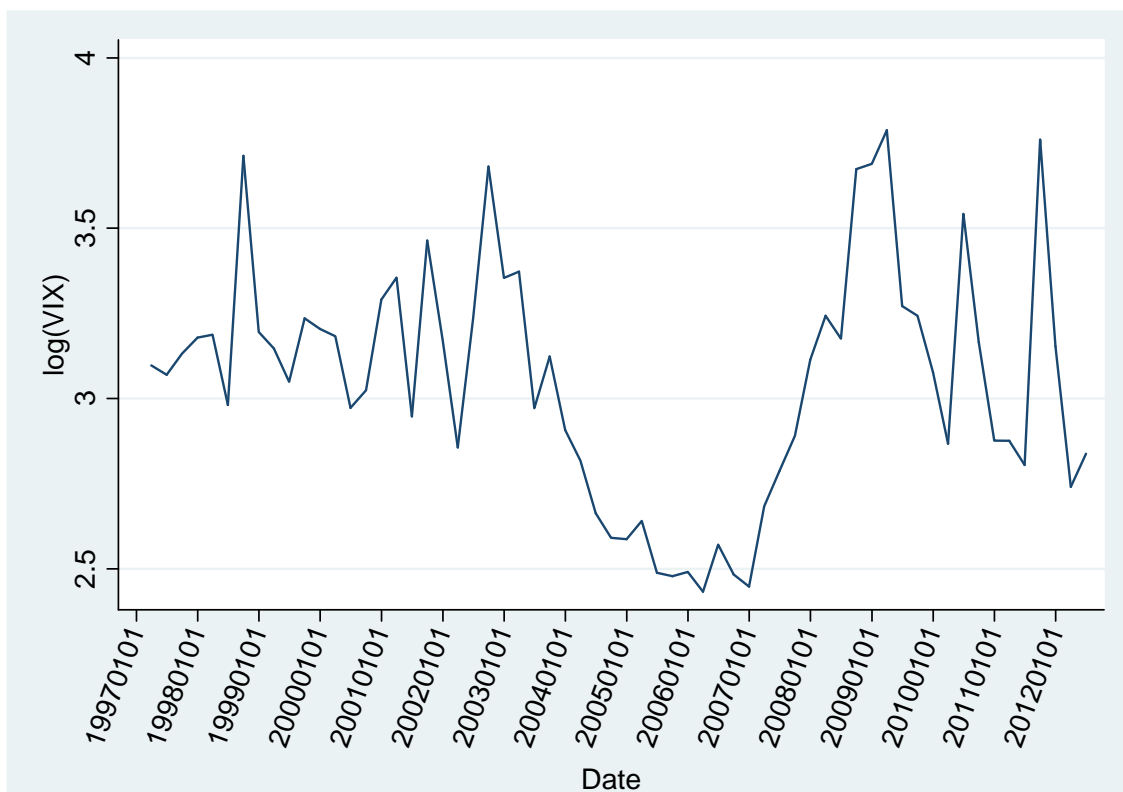


**Figure 10:** Heterogeneous effects of shocks for different levels of the VIX



Note: The graph shows the estimated effect of a country-level supply shock on export growth as a function of the size of the export market for different levels of the VIX. The size of an export market is measured by the logarithm of the average U.S. exports to a country from the first quarter of 1997 to the second quarter of 2012. The circles in the graph indicate the effect when the VIX takes its maximum value observed in the first quarter of 2012. The diamonds represent the effect when the VIX takes its minimum observed in the first quarter of 2006 .

**Figure 11:** The evolution of the log of the VIX over time



Note: The graph shows the evolution of the log of the CBOE Volatility Index from 1997 to 2012. Quarterly averages of the VIX were calculated from daily data.

**Table 1:** Different forms of bank trade finance and underlying trade transactions captured 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                 |

**Table 2:** Summary statistics of banks' market shares and the number of trade finance suppliers

|              | 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  |

**Table 3:** Persistence in bank shares

|  | (1)                     | (2)                     | (3)                     |
|--|-------------------------|-------------------------|-------------------------|
| $\phi_{ibt-1}$   | 0.913***<br>(0.00331)   |                         | 0.704***<br>(0.0132)    |
| $\phi_{ibt-2}$   |                         | 0.880***<br>(0.00399)   | 0.236***<br>(0.0132)    |
| Constant   | 0.0161***<br>(0.000550) | 0.0240***<br>(0.000705) | 0.0121***<br>(0.000544) |
| Observations   | 32,896                  | 29,538                  | 28,196                  |
| R-squared  | 0.836                   | 0.773                   | 0.854                   |
| Robust standard errors in parentheses.<br>*** p<0.01, ** p<0.05, * p<0.1 |                         |                         |                         |

**Table 4:** Persistence in the number of banks active in a market

|  | (1)                   | (2)                   | (3)                  |
|--|-----------------------|-----------------------|----------------------|
| $n_{it-1}$   | 0.956***<br>(0.00440) |                       | 0.690***<br>(0.0173) |
| $n_{it-2}$   |                       | 0.925***<br>(0.00547) | 0.265***<br>(0.0173) |
| Constant   | 0.189***<br>(0.0210)  | 0.292***<br>(0.0263)  | 0.162***<br>(0.0215) |
| Observations   | 6,914                 | 6,697                 | 6,587                |
| R-squared  | 0.947                 | 0.924                 | 0.950                |
| Robust standard errors in parentheses.<br>*** p<0.01, ** p<0.05, * p<0.1 |                       |                       |                      |

**Table 5:** Summary statistics of bank- and country-supply shocks

| variable                        | N      | mean  | p50   | sd    | min    | max   |
|---------------------------------|--------|-------|-------|-------|--------|-------|
| bank shock $\alpha_{ibt}$       | 35,919 | 0.097 | 0.112 | 0.522 | -2.847 | 6.038 |
| country shock $\Delta t f_{it}$ | 7,347  | 0.022 | 0.028 | 0.375 | -1.848 | 1.702 |

**Table 6:** Correlation of estimated bank shocks with balance sheet items

|  | (1)              | (2)              | (3)               |
|--|------------------|------------------|-------------------|
| deposit growth <sub>bt</sub>   | 0.366<br>(0.294) |                  | 0.0527<br>(0.190) |
| loan growth <sub>bt</sub>  |                  | 0.472<br>(0.290) | 0.438*<br>(0.230) |
| Observations   | 1,801            | 1,801            | 1,801             |
| R-squared  | 0.435            | 0.439            | 0.439             |
| Robust standard errors in parentheses.<br>*** p<0.01, ** p<0.05, * p<0.1 |                  |                  |                   |

**Table 7:** Predicting observed trade finance growth rates using bank-level shocks

|   | (1)                 | (2)                 | (3)                 |
|---|---------------------|---------------------|---------------------|
| $\alpha_{ibt}$  | 0.350***<br>(0.121) | 0.859***<br>(0.226) | 0.982***<br>(0.283) |
| Observations  | 31,566              | 31,566              | 31,566              |
| R-squared   | 0.000               | 0.009               | 0.297               |
| Country FE  | no                  | yes                 | no                  |
| Time FE   | no                  | yes                 | no                  |
| Time-County FE  | no                  | no                  | yes                 |
| Clustered standard errors in parentheses.<br>*** p<0.01, ** p<0.05, * p<0.1 |                     |                     |                     |

**Table 8:** Testing whether bank-level supply shocks are serially correlated

|   | (1)                 | (2)                 | (3)                 |
|---|---------------------|---------------------|---------------------|
| $\bar{\alpha}_{bt-1}$                   | -0.0204<br>(0.0342) | -0.0246<br>(0.0352) | -0.0206<br>(0.0403) |
| $\bar{\alpha}_{bt-2}$                   |                     | 0.0261<br>(0.0258)  | 0.0274<br>(0.0298)  |
| $\bar{\alpha}_{bt-3}$                   |                     |                     | 0.0441<br>(0.0316)  |
| $\bar{\alpha}_{bt-4}$                   |                     |                     | -0.0355<br>(0.0296) |
| Observations                            | 1,704               | 1,575               | 1,369               |
| R-squared                               | 0.458               | 0.461               | 0.453               |
| Robust standard errors in parentheses.  |                     |                     |                     |
| Regressions include time-fixed effects. |                     |                     |                     |
| *** p<0.01, ** p<0.05, * p<0.1          |                     |                     |                     |

**Table 9:** Baseline results

|  | (1)                  | (2)                  | (3)                    | pos. shock<br>(4)  | neg. shock<br>(5)   | neg. & pos. shock<br>(6) | crisis<br>(7)      | no crisis<br>(8)    |
|--|----------------------|----------------------|------------------------|--------------------|---------------------|--------------------------|--------------------|---------------------|
| shock <sub>it</sub>  | 0.0571**<br>(0.0267) | 0.0572**<br>(0.0275) | 0.0537*<br>(0.0275)    |                    |                     |                          | 0.0683<br>(0.0574) | 0.0566*<br>(0.0306) |
| imp growth <sub>it</sub>   |                      |                      | 0.000383<br>(0.000995) |                    |                     |                          |                    |                     |
| pos shock <sub>it</sub>  |                      |                      |                        | 0.0456<br>(0.0364) |                     | 0.0390<br>(0.0367)       |                    |                     |
| neg shock <sub>it</sub>  |                      |                      |                        |                    | 0.0901*<br>(0.0486) | 0.0853*<br>(0.0489)      |                    |                     |
| Observations   | 5,824                | 5,824                | 5,813                  | 5,824              | 5,824               | 5,824                    | 768                | 5,056               |
| R-squared  | 0.047                | 0.079                | 0.079                  | 0.078              | 0.079               | 0.079                    | 0.176              | 0.076               |
| Time-FE  | yes                  | yes                  | yes                    | yes                | yes                 | yes                      | yes                | yes                 |
| Country-FE   | no                   | yes                  | yes                    | yes                | yes                 | yes                      | yes                | yes                 |
| Robust standard errors in parentheses.<br>*** p<0.01, ** p<0.05, * p<0.1 |                      |                      |                        |                    |                     |                          |                    |                     |

**Table 10:** Shocks of the top five versus smaller banks

|  | (1)                  | (2)                  | (3)                  |
|--|----------------------|----------------------|----------------------|
| shock big <sub>it</sub>                              | 0.0691**<br>(0.0302) |                      | 0.0755**<br>(0.0324) |
| shock small <sub>it</sub>                            |                      | -0.00748<br>(0.0307) | 0.0234<br>(0.0329)   |
| Observations   | 5,824                | 5,824                | 5,824                |
| R-squared  | 0.079                | 0.078                | 0.079                |
| Robust standard errors in parentheses.               |                      |                      |                      |
| Regressions include time- and country-fixed effects. |                      |                      |                      |
| *** p<0.01, ** p<0.05, * p<0.1                       |                      |                      |                      |



**Table 11:** Heterogeneous effects on export growth across countries

|   | (1)                    | (2)                     | (3)                     | (4)                    | small countries<br>(5) | large countries<br>(6) |
|---|------------------------|-------------------------|-------------------------|------------------------|------------------------|------------------------|
| $\text{shock}_{it}$                                   | -0.0396<br>(0.0562)    | 0.222*<br>(0.131)       | 0.0829**<br>(0.0333)    | 0.372**<br>(0.149)     | 0.117***<br>(0.0440)   | 0.00630<br>(0.0252)    |
| $\text{risk}_{it} \times \text{shock}_{it}$           | 0.00214**<br>(0.00103) | -0.0103*<br>(0.00619)   |                         |                        |                        |                        |
| $\text{risk}_{it}$                                    | -0.000804<br>(0.00119) | -0.00293<br>(0.00528)   |                         |                        |                        |                        |
| $\text{risk}_{it}^2 \times \text{shock}_{it}$         |                        | 0.000138*<br>(7.08e-05) |                         |                        |                        |                        |
| $\text{risk}_{it}^2$                                  |                        | 2.26e-05<br>(5.47e-05)  |                         |                        |                        |                        |
| $\# \text{banks}_{it-1} \times \text{shock}_{it}$     |                        |                         | -0.00457**<br>(0.00204) |                        |                        |                        |
| $\# \text{banks}_{it-1}$                              |                        |                         | -0.000150<br>(0.00111)  |                        |                        |                        |
| $\log(\text{mean exp})_{it} \times \text{shock}_{it}$ |                        |                         |                         | -0.0133**<br>(0.00585) |                        |                        |
| Observations  | 3,523                  | 3,523                   | 5,824                   | 5,824                  | 2,855                  | 2,969                  |
| R-squared   | 0.093                  | 0.094                   | 0.080                   | 0.080                  | 0.080                  | 0.223                  |
| Robust standard errors in parentheses.                |                        |                         |                         |                        |                        |                        |
| Regressions include time- and country-fixed effects.  |                        |                         |                         |                        |                        |                        |
| *** p<0.01, ** p<0.05, * p<0.1                        |                        |                         |                         |                        |                        |                        |

**Table 12:** Robustness I

|   | (1)                | (2)                     | (3)                      | (4)                    | (5)                    |
|---|--------------------|-------------------------|--------------------------|------------------------|------------------------|
| $\text{shock}_{it}$                                   | 0.0704<br>(0.0480) | -0.0233<br>(0.0879)     | 0.269*<br>(0.153)        | 0.0947*<br>(0.0532)    | 0.386**<br>(0.158)     |
| $\text{risk}_{it} \times \text{shock}_{it}$           |                    | 0.00284***<br>(0.00108) | -0.0110*<br>(0.00646)    |                        |                        |
| $\text{risk}_{it}$                                    |                    | -0.000755<br>(0.00119)  | -0.00348<br>(0.00532)    |                        |                        |
| $\text{risk}_{it}^2 \times \text{shock}_{it}$         |                    |                         | 0.000154**<br>(7.44e-05) |                        |                        |
| $\text{risk}_{it}^2$                                  |                    |                         | 2.95e-05<br>(5.52e-05)   |                        |                        |
| $\# \text{ banks}_{it-1} \times \text{shock}_{it}$    |                    |                         |                          | -0.00402*<br>(0.00228) |                        |
| $\# \text{ banks}_{it-1}$                             |                    |                         |                          | -0.000416<br>(0.00112) |                        |
| $\log(\text{mean exp})_{it} \times \text{shock}_{it}$ |                    |                         |                          |                        | -0.0134**<br>(0.00610) |
| Observations  | 5,824              | 3,523                   | 3,523                    | 5,824                  | 5,824                  |
| R-squared   | 0.079              | 0.094                   | 0.095                    | 0.079                  | 0.080                  |
| Robust standard errors in parentheses.                |                    |                         |                          |                        |                        |
| Regressions include time- and country-fixed effects.  |                    |                         |                          |                        |                        |
| *** p<0.01, ** p<0.05, * p<0.1                        |                    |                         |                          |                        |                        |

**Table 13:** Robustness II

|  | 1q-lag<br>(1)        | 3q-lag<br>(2)        | 2q-lag<br>(3)        |
|--|----------------------|----------------------|----------------------|
| shock <sub>it</sub>                                  | 0.0509**<br>(0.0249) | 0.0598**<br>(0.0275) | 0.0671**<br>(0.0294) |
| pop growth <sub>it</sub>                             |                      |                      | -2.378***<br>(0.658) |
| GDP growth <sub>it</sub>                             |                      |                      | -0.0652<br>(0.0762)  |
| USD xrate growth <sub>it</sub>                       |                      |                      | -0.184**<br>(0.0804) |
| non-U.S. imports <sub>it</sub>                       |                      |                      | 0.335***<br>(0.0506) |
| Observations   | 5,824                | 5,824                | 5,295                |
| R-squared  | 0.079                | 0.079                | 0.094                |
| Robust standard errors in parentheses.               |                      |                      |                      |
| Regressions include time- and country-fixed effects. |                      |                      |                      |
| *** p<0.01, ** p<0.05, * p<0.1                       |                      |                      |                      |

**Table 14:** Quantifications

| Region                      | Bank A  | Bank B  |
|-----------------------------|---------|---------|
| East Asia and Pacific       | -0.279% | -0.376% |
| Europe and Central Asia     | -0.316% | -0.457% |
| Latin America the Caribbean | -0.828% | -0.400% |
| South Asia                  | -0.883% | -0.328% |