DISSECTING THE EFFECT OF CREDIT SUPPLY ON TRADE:
EVIDENCE FROM MATCHED CREDIT-EXPORT DATA

Daniel Paravisini
Veronica Rappoport
Philipp Schnabl
Daniel Wolfenzon

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Daniel Paravisini, Veronica Rappoport, Philipp Schnabl, and Daniel Wolfenzon
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<u>ABSTRACT</u>

We estimate the elasticity of exports to credit using matched customs and firm-level bank credit data from Peru. To account for non-credit determinants of exports, we compare changes in exports of the same product and to the same destination by firms borrowing from banks differentially affected by capital flow reversals during the 2008 financial crisis. We obtain elasticity estimates for the intensive and extensive margins of exports, size and frequency of shipments, and the method of freight and payment. Our results suggest that the credit shortage reduces exports through raising the variable cost of production, rather than the cost of financing sunk entry investments.

Daniel Paravisini
Department of Finance
London School of Economics
Houghton Street
London WC2A 2AE
and NBER
d.paravisini@lse.ac.uk

Veronica Rappoport
London School of Economics
v.e.rappoport@lse.ac.uk

Philipp Schnabl
Stern School of Business
New York University
44 West Fourth Street
New York, NY 10012
and NBER
schnabl@stern.nyu.edu

Daniel Wolfenzon
Graduate School of Business
Columbia University
Uris Hall, Room 808
3022 Broadway
New York, NY 10027
and NBER
dw2382@columbia.edu

1 Introduction

The role of banks in the amplification of real economic fluctuations has been debated by policymakers and academics since the Great Depression (Friedman and Schwarz (1963), Bernanke (1983)). The basic premise is that funding shocks to banks during economic downturns increase the real cost of financial intermediation and reduce borrowers access to credit and output. Through this channel, international commercial banks have been shown to represent an important source of contagion during periods of international capital reversals.[1] Although there is now a large body of evidence suggesting that negative bank credit shocks may affect economic activity, the magnitude of the sensitivity of output to bank funding shocks is unknown, and the underlying economic mechanisms behind this sensitivity are less understood.[2]

In this paper we study empirically the impact of bank funding shocks on economic activity using disaggregated firm export data. Measuring firm output with disaggregated export data allows us to dissect the effect of credit on economic activity along three novel dimensions. First, we empirically decompose the effect of credit on output into the credit supply shock and the sensitivity of exports to credit fluctuations. In doing so, we provide the first estimates of a firm's elasticity of output to credit, a key input for parameterizing quantitative analysis. Second, we use customs data at the shipment level to decompose the export elasticity to credit in its intensive and extensive margins, as well as to measure the elasticity of other dimensions of the export activity (shipment size and frequency, freight and payment method). Third, we test the validity of the identification assumptions behind existing empirical methodologies based on aggregate data.[3]

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[1]See Schnabl (2010), Cetorelli and Goldberg (2010), Puri et al. (2011), and IMF (2009).

[2]For early evidence see, for example, Bernanke and Blinder (1992), Kashyap et al. (1994), Kashyap and Stein (2000), Peek and Rosengren (2000), and Ashcraft (2005).

[3]The literature that studies the effect of financial shocks on trade has been limited by the use of export data aggregated at the sector-destination level or the firm level, and/or the unavailability of bank credit information. See, for example, Amiti and Weinstein (2011), Bricongne et al. (2009), Iacovone and Zavacka (2009), and Chor and Manova (2010).

We study the export behavior of Peruvian firms during the 2008 financial crisis. The funding of banks operating in Peru was negatively affected by the reversal of capital flows during the crisis. We use this funding shortage, which was particularly pronounced among banks with a high share of foreign liabilities, as a source of variation for the supply of credit to their related firms. To overcome concerns that unobserved demand and input market shocks might be correlated with the credit supply shock, we rely on the disaggregated nature of our data to account for these non-credit shocks: We compare the export growth of the *same* product and to the *same* destination of firms that borrow from banks that were subject to these heterogeneous funding shocks.

To illustrate the intuition behind this approach consider, for example, two firms that export *Men's Cotton Overcoats* to the *U.S.*[4] Suppose that one of the firms obtains all its credit from Bank A, which had a large funding shock, while the other firm obtains all its credit from Bank B, which did not. Changes in the demand for overcoats in the U.S., or changes in the financial condition of coat importers in the U.S. should, in expectation, affect exports by both firms in a similar way. Also, any real shock to the production of overcoats in Peru, e.g. changes in the price of cotton or wage fluctuation in the garment industry, should affect both firms' exports the same way. Thus, the change in export performance in a product-destination of a firm that borrows from Bank A relative to a firm that borrows from Bank B isolates the effect of credit on exports. We use an instrumental variable approach based on this intuition to estimate the credit elasticity of exports.

We start by showing that banks that rely heavily on foreign funding before the financial crisis reduced significantly the supply of credit when capital flows reversed during 2008. We demonstrate, using the within-firm estimator from recent work on the lending channel, that the supply of credit by banks with above average share of foreign liabilities declined

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[4]The example coincides with the 6-digit product aggregation in the Harmonized System, used in the paper.

by 17% after July 2008.[5] Consistent with the hypothesis that the credit supply decline was caused by the foreign funding shortage, the entire credit supply decline occurs through foreign currency denominated loans.

We estimate the credit elasticity of exports at both the intensive and extensive margin. On the intensive margin, we find that a 10% reduction in the supply of credit results in a contraction of 1.8% in the (one year) volume of export flows for those firm-product-destination flows active before and after the crisis. On the extensive margin, a 10% decline in credit supply increases the probability that a firm exits a given market by 0.3 percentage points, and does not affect significantly the probability that a firm enters a new export market.

The estimated intensive and extensive margin elasticities provide new insights on the relationship between exporters' production function and their use of credit. Consider, for example, the benchmark model of trade with sunk entry costs.[6] In such a framework, a negative credit shock affects the entry margin, but once the initial investment is paid, credit fluctuations do not affect the intensive margin of trade or the probability of exiting an export market. Yet, we find positive elasticities both on the intensive and exit margins, suggesting that credit shocks affect the *variable* cost of exporting. This would be the case, for example, if banks financed exporters' working capital, as in Feenstra et al. (2011). By increasing the unit cost of production, adverse credit conditions reduce the equilibrium size and profitability of exports, and induce firms to discontinue export flows.

We further characterize firms' cost structure by identifying the nature of the fixed cost of exporting. After a credit shock, firms adjust the intensive margin of exports

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[5]For applications of within-firm estimators in banking see, for example, Gan (2007), Khwaja and Mian (2008), Paravisini (2008), Iyer et al. (2010), Iyer and Peydro (2010), Schnabl (2010), Jimenez, Mian, Peydro and Saurina (2011) and Jimenez, Ongena, Peydro and Saurina (2011).

[6]See, among others, Baldwin and Krugman (1989), Roberts and Tybout (1999), and Melitz (2003). Motivated by the important fixed costs involved in entering a new market—i.e. setting up distribution networks, marketing– Chaney (2005) develops a model where firms are liquidity constrained and must pay an export entry cost. Participation in the export market is, as a result, suboptimal.

by changing the frequency of shipments of a given product to a given destination (with elasticity 0.11), while keeping the volume size of the shipment constant. This suggests the existence of a fixed cost of exporting at the shipment level.

We also find that the credit arrangements between the exporter and the importer react to funding shocks to the exporting firm: after bank credit supply declines, exporting firms firms partially substitute towards trade credit with the importer. The magnitude of the effect is economically small: A 10% reduction in bank lending triggers an increase of 0.33% in the fraction of the shipment paid in advanced by the importer. This is consistent with the findings in Antras and Foley (2011), who document stickiness in the terms of the trade credit contracts between established trade partners during the 2008 financial crisis.

This paper is related to a growing empirical literature aimed at analyzing the role of credit on export activities. A large portion of this literature has focussed on the link between access to credit and the steady state patterns of international trade and comparative advantages.[7] The focus of our paper is not on the static patterns of exports, but rather the effect of a credit shock on their export performance. Our motivation is, therefore, similar to those analyzing the effect of credit disruptions in explaining the Great Trade Collapse of 2008. Most of these studies are based on the comparison of exports across industries presumed to differ in their sensitivity to credit.[8] We can use our setting to test whether these industry-level indicators are, indeed, predictors of the sensitivity of exports to credit shocks. We find no evidence to support the common assumption that sectors with high dependence on external finance, as measured in Rajan and Zingales (1998), have a higher export elasticity to credit supply shocks in the intensive and the

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[7]Manova (2013), for example, looks at cross-country differences in financial conditions and the resulting patterns of exports across industries. And, related to *static* models of trade with heterogeneous firms and credit constraints, as in Chaney (2005), there is recent empirical literature aimed at analyzing, using cross-sectional firm-level data, the effect of credit constraints on firms participation in export markets. See, for example, Manova et al. (2009), Minetti and Zhu (2011), Muûls (2008) and Berman and Hericourt (2008).

[8]For studies based on cross-industry comparisons see, among others, Beck (2003), Bolton et al. (2010), Chor and Manova (2010), Levchenko et al. (2010).

exit margins. These measure of external finance dependence captures an industry's long-term need for outside financing but does not capture short-term sensitivity to changes in the credit supply. Dependence on external finance only appears to correlate with the credit elasticity of the entry probability, which accounts for a very small fraction of the aggregate variation in export flows.

Most existing work on the real effects of the bank lending channel compares firm level outcomes—such as total sales, total exports, employment or investment–across firms differently affected by a credit shock (see for example Amiti and Weinstein (2011), Carvalho et al. (2010), Chodorow-Reich (2013), Iyer et al. (2010), Jimenez, Mian, Peydro and Saurina (2011), and Kalemli-Ozcan et al. (2010)). We find that comparing across firms without accounting for non-credit shocks to their different markets of operation can result in an important estimation bias. In our setting, the elasticity of exports to credit is biased downward by a factor of nine if it is estimated without accounting for export demand and input price variations at the product-destination level. Moreover, we find that, when those non-credit shocks are properly accounted for, the variables typically used in the literature as a proxy for trade-specific financing demand do not have the predicted interaction with the effect of credit shocks. That is: the effect of credit shocks on exports does not vary with distance to destination, the mode of transportation (air vs. sea or ground), or whether the exported goods where paid in advanced by the importer.[9]

The sizable magnitude of the bias shows the importance of non-credit factors during the great trade collapse.[10] Indeed, in the case of Peru, our estimates suggest that while bank credit appears to have a first order effect on trade, the bulk of the decline in the volume of exports during the analysis period is explained by the drop in international demand for Peruvian goods. Peruvian exports volume growth was -9.6% during the year

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[9]The interaction of time-to-ship and credit frictions is emphasized, among others, in Amiti and Weinstein (2011), Leibovici and Waugh (2013), and Berman et al. (2012).

[10]For evidence of non-financial determinants of the 2008 trade collapse, see Alessandria et al. (2010), Bems et al. (2010), Eaton et al. (2010), and Levchenko et al. (2010).

following July 2008, almost 13 percentage points lower than the previous year. Assuming that only banks with above average foreign liabilities to assets reduced their supply of credit, the estimated elasticities imply that the credit supply decline accounts for about 15% of the missing volume of exports.

The rest of the paper proceeds as follows. Section 2 describes the data. Section 3 discusses the empirical strategy and describes the Peruvian banking sector during the 2008 financial crisis. Section 4 presents the estimates of the export elasticity to credit supply. Section 5 tests the validity of several key assumptions in existing empirical work aimed at measuring the effect of credit shocks on real economic activity. Finally, section 6 concludes and performs a *back of the envelope* calculation of the contribution of finance to the overall export decline during the the 2008 crisis.

2   Data Description

We use three data sets: bank level data on Peruvian banks, loan level data on credit in the domestic banking sector, and customs data for Peruvian firms.

We collect the customs data from the website of the Peruvian tax agency (Superintendence of Tax Administration, or SUNAT). Collecting the export data involves using a web crawler to download each individual export document. To validate the consistency of the data collection process, we compare the sum of the monthly total exports from our data, with the total monthly exports reported by the tax authority. On average, exports from the collected data add up to 99.98% of the exports reported by SUNAT. We match the loan data to export data using a unique firm identifier assigned by SUNAT for tax collection purposes.

The bank and credit data are from the Peruvian bank regulator, Superintendence of Banking, Insurance, and Pension Funds (SBS). The bank data consist of monthly financial statements for all of Peru's commercial banks from January 2007 to December

2009. Columns 1 to 3 in Table 1 provide descriptive statistics for the 13 commercial banks operating in Peru during this period. The credit data are a monthly panel of the outstanding debt of every firm with each bank operating in Peru.

Peruvian exports in 2009 totaled almost $27bn, approximately 20% of Peru's GDP. North America and Asia are the main destinations of Peruvian exports; in particular United States and China jointly account for approximately 30% of total flows. The main exports are extractive activities: goods derived from gold and copper account for approximately 40% of Peruvian exports. Other important sectors are food products (coffee, asparagus, and fish) and textiles.

In the time series, Peruvian exports grew steadily over the last decade until the 2008 financial crisis and suffered a sharp drop after 2008. Figure 1 shows the monthly (log) export flows between 2007 and 2009. Peak to trough, monthly exports dropped around 60% in value (40% in volume) during the 2008 financial crisis. The timing and magnitude of this decline aligns closely with the sharp collapse of world trade during the last quarter of 2008.

Panel 1 in Table 2 provides descriptive statistics of Peruvian exporters. Our data cover the universe of exporters, which are all firms with at least one export shipment registered between July 2007 and June 2009. The descriptive statistics correspond to the period July 2007-June 2008, prior to the capital flow reversal caused by the 2008 crisis (next section explains this timing choice in more detail). The average bank debt outstanding of the universe of exporters as of December 2007 is $1.01 million and the average level of exports is $3.3 million FOB (Free On Board). The average firm exports to 2.7 destinations, out of a total of 198. The average firm exports 5.3 four-digit products (out of a total of 1,103 products with positive export flows in the data). Our empirical analysis in Section 4 is based on exporting firms with positive debt in the domestic banking sector, both, before and after the negative credit supply shock. As shown in Table 2, firms in this subsample

are larger than in the full sample. For example, average exports in the analysis sample is $4.0 million, and average debt outstanding is $1.25 million.

The unit of observation in our baseline regressions is a firm-product-destination annual export flow. Panel 2 in Table 2 provides the descriptive statistics for the universe of 53,690 export flows and for the 47,810 observations that correspond to our sample of exporters. The average annual export flow in our sample is US$184,800 FOB (446,400 kg), and is distributed into 2.17 shipments. Approximately a third of these export flows are paid in advance by the importer. A similar proportion is shipped by air, the rest is transported by sea or ground. To estimate the effect of credit on the intensive margin of trade, the sample is restricted to around 16,500 firm-product-destination export flows that are positive (at least one shipment), both, in the period July 2007-June 2008 and July 2008-June 2009, the years before and after the beginning of the capital flow reversal. The effect on the extensive margin is estimated using all positive firm-product-destination export flows.

3   Empirical Strategy

This section describes our approach to identifying the causal effect of finance on exports. Consider the following general characterization of the level of exports by firm i of product p to destination country d at time t, X_{ipdt}.

$$X_{ipdt} = X_{ipdt}(H_{ipdt}, C_{it}). \tag{1}$$

The first argument, H_{ipdt}, represents determinants of exports other than finance, i.e. demand for product p in country d, financial conditions in country d, the cost of inputs for producing product p, the productivity of firm i, etc. The second argument, C_{it}, represents the amount of credit taken by the firm.

We are interested in estimating the elasticity of trade to credit: $\eta = \frac{\partial X}{\partial C} \frac{C}{X}$. The

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identification problem is that the amount of credit, C_{it}, is an equilibrium outcome that depends on the supply of credit faced by the firm, S_{it}, and the firm's demand for credit, which may be given by the same factors, H_{ipdt}, affecting the level of exports:

$$C_{it} = C_{it}(H_{ipdt}, ..., S_{it}). \qquad (2)$$

Our empirical strategy to address this problem is based on two pillars. First, we instrument for the supply of credit, using shocks to the balance sheet of the banks lending to firm i. This empirical approach obtains unbiased parameters if banks and firms are randomly matched. However, if banks specialize by firms' product or destination markets, the instrument may be correlated to factors that affect exports though channels other than the supply of credit. For example, suppose that banks suffering a negative balance sheet shock specialize in firms that export *Men's Cotton Overcoats* to the U.S. If the demand for Men's Cotton Overcoats in the U.S. drops disproportionately during the crisis, we would erroneously attribute this decline in exports to the credit supply shock.

To avoid potential bias due to non-random matching of firms and banks, a second pillar of our empirical strategy involves controlling for all heterogeneity in the cross section with firm-product-destination fixed effects, and for shocks to the productivity and demand of exports with product-country-time dummies.[11] Instead of comparing total exports across firms, our estimation compares exports within product-destinations. In the example above, our estimation procedure compares the change in Men's Cotton Overcoat exports to the U.S. by a firm that is linked to a negatively affected bank, relative to the change in Men's Cotton Overcoat exports to the U.S. of a firm whose lender is not affected.

The identification assumption is that factors other than bank credit that may affect the exports of mens' cotton overcoats to the U.S. differentially across these two firms

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[11]Subsection 5.1 shows that the impact of the credit shock on export is severely misestimated if the model does not control for heterogeneity of non-credit factors across product and destinations.

during the crisis are not related to the banks the firms borrow from. Note that this assumption is much weaker than the one required for estimation using exports aggregated at the firm level, which does not allow controlling for shocks in the firm's export or input markets. The identification assumption is violated if a firm's bank affiliation is correlated with: 1) demand heterogeneity within a product-destination (e.g. product quality), or 2) other non-credit firm level shocks (e.g. firm direct dependence to foreign funding, not mediated by banks). We discuss and test the validity of these assumptions in Subsection 4.4, where we show that the elasticity point estimates are unchanged when we allow the effect of credit to exports to vary across firms that export products of different quality, firms that have different currency composition of their liabilities, single and multi-product firms, and small and large firms measured both by volume of exports and by number of destinations. This robustness provides strong support for our identification assumption.

Summarizing, we estimate η, the elasticity of exports to credit, using the following empirical model of exports:

$$\ln(X_{ipdt}) = \eta \cdot \ln(C_{it}) + \delta_{ipd} + \alpha_{pdt} + \varepsilon_{ipdt}, \tag{3}$$

where, as in equation (1) above, X_{ipdt} represents the exports by firm i of product p to destination country d at time t and C_{it} is the the sum of all outstanding credit from the banking sector to firm i at time t. The right-hand side includes two sets of dummy variables that account for the cross sectional unobserved heterogeneity of product p exported to destination d by firm i, δ_{ipd}, and the product-destination-time shocks, α_{pdt}. The first component captures, for example, the managerial ability of firm i, or the firm knowledge of the market for product p in destination d. The second component captures changes in the cost of production of good p, variations in the transport cost for product p to destination d, or any fluctuation in the demand for product p at destination d.

By construction, specification (3) measures the export elasticity to credit in the inten-

sive margin: how the volume of exports by firm i of product p to destination d changes with a change in the supply of credit, conditional on the amount on exports by firm i of product p to destination d being positive before and after the credit supply change. To measure the extensive margin elasticity —the change in the probability that firm i starts/stops exporting product p to destination d— we use the following linear probability model:

$$E_{ipdt} = \eta_E \cdot \ln(C_{it}) + \delta_i + \alpha_{pdt} + \varepsilon_{ipdt}, \tag{4}$$

We are interested in measuring separately the elasticity of entry and exit to a credit shock, so we estimate two specifications: In the *entry* specification, E_{ipdt} is an indicator variable for whether exports by firm i of product p to destination d is positive at time t, conditioning on exports being zero in the previous period. In the *exit* specification, E_{ipdt} is one if the firm i *does not* export product p to destination t at time t, conditioning on exports being positive in the previous period. Note a key difference between the extensive margin specification (4) and the intensive margin specification (3): it contains only firm fixed-effects, instead of firm-product-destination fixed effects. This is by construction, since a firm that enters (exits) a product-destination market cannot enter (exit) the same product-destination market the following period. Thus, η_E can be interpreted as a firm-level semi-elasticity: it measures the change in the probability that a firm enters/exits a new product-destination market that is induced by a one percentage point change in credit supply.

We estimate equations (3) and (4) using shocks to the financial condition of the banks lending to firm i as an instrument for the amount of credit received by firm i at time t, C_{it}. We next explain the economic rationale behind the instrument, and further discuss the identification hypothesis behind the instrumental variable (IV) estimation.

3.1 Capital Flow Reversals, Bank Foreign Liabilities and Credit Supply

The 2008 financial crisis affected Peru through two main channels. First, international demand and prices for Peruvian exports dramatically dropped during this period. And second, portfolio capital inflows to Peru, which were growing prior to the crisis, stopped suddenly in mid 2008. Foreign liabilities of Peruvian banks exhibit the same evolution (see Figure 1). As it can be seen in Figure 1, this reversal of foreign capital flows is not specific to the 2008 financial crisis; a similar phenomenon occurred during the Russian crisis of 1998. More generally, during episodes of international financial turmoil, capital flows away from emerging economies and towards more secured financial assets in developed economies—a phenomenon known as *flight-to-quality*.

Peru's GDP growth slowed down from 6.5% in the fourth quarter of 2008 to 1.8% in the first quarter of 2009. Bank lending followed a similar trend: total bank loan growth dropped from 2.4% between March and September 2008, to 1.6% during the following six months.[12] This disacceleration was solely due to the change in trend for dollar-denominated credit. Lending in domestic currency (Soles) grew at a fairly constant rate throughout the entire period.

The drop in the volume of dollar-denominated credit occurred concurrently with an increase in the cost of dollar-denominated debt: the spread between lending and deposit dollar-denominated interest rates increased from 6.7% to 9.6% between March and December 2008; and the U.S. dollar appreciated more than 10% with respect to the domestic currency.[13] Although a decline in demand —due to the drop in export and import activities— may be partly to blame for the drop in dollar-denominated credit, the rate in-

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[12]The account of the 2008 financial crisis described in this subsection draws heavily on the "Report on Financial Stability", Banco Central de Reserva del Peru (2009).

[13]During the same period, due to active intervention of the Central Bank of Peru, the spread between active and passive Soles-denominated interest rates dropped from 21.7% to 17.2%. These figures correspond to the average rates of commercial banks on lending and deposit (weighted).

crease highlights the importance of supply side factors. Commercial banks reacted to the increased cost of dollar-denominated borrowing by reducing the share of foreign liabilities. This was particularly taxing for banks with high share of foreign liabilities.

Many non-U.S. financial institutions fund their U.S. dollar lending by borrowing in international wholesale deposit markets. The lenders in these markets are mostly short-term investors such as U.S. money market funds or U.S. banks with surplus deposit funding. The maturity of this funding is usually short-term with a maturity of a month or less. As a result, shocks to this source of funding are transmitted almost immediately to banks balance sheets and subsequently lead to a decline in dollar-denominated lending. For example, Ivashina, Scharfstein, and Stein (2013) analyze the transmission of a such a shock to U.S. dollar lending of European banks during the recent financial crisis.

Although the transmission of the 2008 international crisis into the Peruvian economy resembles that of the 1998 episode, the consequences for the financial sector of the two crises were different. The average share of foreign liabilities across commercial banks in 1998 was 17%; the funding shock resulted in the bankruptcy and posterior restructuring of several banking institutions.[14] In the aftermath of the Russian crisis, the Central Bank and the SBS implemented a number of prudential banking regulations that increased the cost of foreign borrowing by the banking sector —for example, higher reserve requirements for foreign-currency liabilities than for local-currency denominated ones. As a result, by 2007 the average share of foreign liabilities was reduced to 9.5%. During the 2008 financial crisis, no commercial bank went into bankruptcy and the rate of non-performing loans did not increase substantially.[15]

Our empirical strategy relies on the heterogeneous effect of the 2008 crisis across commercial banks. The hypothesis behind the instrumental variable approach is that

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[14]See Schnabl (2010) for the characterization of the funding shock to the Peruvian banking sector during the Russian crisis.

[15]The share of non-performing loans increased slightly for micro-credit and consumption, but it did not change for commercial loans or mortgages.

banks with a larger fraction of their funding from foreign sources before the crisis reduce the supply of credit relative to other banks after the capital flow reversal. In this section we test this identification assumption formally using a *within-firm* estimation procedure to disentangle credit supply from changes in the demand for credit.[16]

To do this, we rank banks according to their dependence on foreign liabilities in 2006, a year before the crisis. Table 1 shows the heterogeneity of the share of foreign liabilities across the thirteen commercial banks in our sample, which are the most important institutions providing credit to exporting firms. For example, the foreign liabilities of HSBC and Banco Santander, two large foreign owned banks operating in Peru, were 17.7% and 2.2% of assets in 2006. There is a relatively large number of small Savings and Loans institutions (S&Ls) with substantial government and international organization funding. These S&Ls have negligible foreign private funding, but their credit supply may change during the crisis for reasons unrelated to their foreign exposure.[17] In particular, small local banks may be financially constrained despite not being exposed to capital flow reversals (see Paravisini (2008) for evidence). For this reason we consider S&Ls as a special category in the credit supply analysis. Also, S&Ls lend almost exclusively to individuals and non exporting small firms. This implies the most of the variation of credit to exporters in the export regressions is driven by commercial banks.

The *within-firm* estimator entails comparing the change in the amount of lending by banks with different dependence on foreign capital to the *same firm*, before and after the capital flow reversal. Based on the evolution of total foreign lending to Peruvian banks in Figure 1, we set July 2008 as the starting date for the capital reversals.[18] This leads

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[16]This procedure has been used in Gan (2007), Khwaja and Mian (2008), Paravisini (2008), Iyer et al. (2010), Iyer and Peydro (2010), Schnabl (2010), Jimenez, Mian, Peydro and Saurina (2011) and Jimenez, Ongena, Peydro and Saurina (2011).

[17]S&L institutions also receive substantial funding from international organizations (World Bank, IDB, etc.). These flows respond to different economic incentives and did not reverse during the financial crisis. Table 1 only reports private foreign funding.

[18]Section 4.4 shows that results are robust to setting the turning point in April 2008, after the collapse of Bearn Stearns.

to the following empirical model:

$$\ln\left(C_{ibt}\right) = \theta_{ib} + \gamma_{it} + \beta \cdot FD_b \times Post_t + \gamma \cdot S\&L_b \times Post_t + \nu_{ibt} \tag{5}$$

C_{ibt} refers to average outstanding debt of firm i with bank b during the intervals $t = \{Pre, Post\}$, where the Pre and $Post$ periods correspond to the 12 months before and after July 2008. FD_b is the share of foreign debt of bank b, and $Post_t$ is a dummy equal to one when $t = Post$ ($S\&L_b$ is a dummy for S&Ls). The regression includes firm-bank fixed effects, θ_{ib}, which control for all (time-invariant) unobserved heterogeneity in the demand and supply of credit. It also includes a full set of firm-time dummies, γ_{it}, that control for the firm-specific evolution in overall credit demand during the period under analysis. As long as changes in a firm's demand for credit are equally spread across different lenders in expectation, the coefficient β measures how credit supply by commercial banks change with with their dependence on foreign funding.

We present in Table 3, column 1, the estimated parameters of specification (5), obtained by first-differencing to eliminate the firm-bank fixed effects, and allowing correlation of the error term at the bank level in the standard error estimation. We find that, indeed, banks transmitted the international funding shock to firms: banks with a higher fraction of foreign liabilities reduced credit supply more during the year of capital flow reversals. The point estimate of -2.3 implies that a 1 percentage point increase in the fraction of foreign funding before the crisis predicts a 2.3 percentage point additional decline in credit supply. In Table 3, column 2, we use as an indicator of exposure a dummy that takes value one if bank-b's share of foreign liabilities is higher than 10% in December 2006 (the mean amongst Commercial Banks is 9.5%). There are four banks in this category, with an average exposure of 14.2%. The coefficient estimate on this dummy implies that Commercial Banks with an above-average share of foreign liabilities reduced credit supply by 17% relative to all other banks in Peru. This estimate is smaller than the one

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implied by the coefficient on the linear exposure estimate, indicating that the relationship between foreign exposure and credit supply during the crisis is not linear, a fact that we will account for in the construction of the instrument.

Consistent with the hypothesis that the credit supply decline was driven by a shortage in dollar funding, the decline is entirely explained by the evolution of dollar denominated loans. The point estimate for β is -3.3 for dollar denominated loans (Table 3, column 3), while the the point estimate changes sign in a specification using local currency denominated loans (column 5). The same is true with the specifications using the dummy measure of exposure (columns 4 and 6). This implies that banks with high foreign exposure reduced the supply of dollar denominated loans during the crisis and only partially offset it by increasing local currency loans. Our results coincide with those in Ivashina et al. (2012), which analyzes dollar-denominated lending by European banks during the 2008 financial crisis.

The results in Table 3 imply that a bank's share of liabilities funded with foreign capital is a good predictor of the supply of bank credit after the capital flow reversals and confirms the main identification assumption behind our instrumental variable approach. Note that the identification assumption tested here is whether the instrument be correlated with the *supply* of credit by banks exposed to the funding shock. In contrast, the first-stage regression of a two-stage-least-squares estimation of equation (3) tests whether the instrument is correlated with the *total amount* of credit received by the borrowers of exposed banks. We present the first stage regression of the instrument on credit in Section 4, and show that this necessary condition also holds.[19]

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[19]If firms can perfectly substitute credit across lenders, a positive in the first test does not imply a positive in the second. In particular, if exposed banks reduce the supply of credit and not-exposed banks expand it to exactly offset the decline in supply, the within-firm estimator will find a correlation between the instrument and credit supply of exposed banks, but the first stage will be zero.

3.2 Instrument

Following the above discussion, we construct the instrument for estimating the baseline estimation of specification (3) by, first, calculating each firm's exposure to capital flow reversals as the weighted average of the shares of foreign liabilities of its lenders:

$$F_i = \sum_b \omega_{ib} FD_b, \tag{6}$$

where ω_{ib} is the share of bank b in total credit of firm i and FD_b is the share of foreign liability of corresponding bank. Both shares correspond to december 2006. The cross sectional variation in F_i comes from two sources: the firm-specific amount of credit that it receives from each bank in 2006, and the heterogeneous dependence to foreign capital across banks. The classification of banks and firms in 2006 reduces the likelihood that bank foreign dependence and firm-bank matching were endogenously chosen in anticipation of the crisis.

The second step in constructing the instrument is interacting a polynomial of the firm level exposure measure with a dummy equal to one after the capital flow reversals begin:

$$F_{it} = \left(F_i + F_i^2 \right) \cdot Post_t \tag{7}$$

$Post_t$ is an indicator variable that turns to one after July 2008, when the decline in foreign funding started. The time series variation in F_{it} is given by the aggregate decline of foreign liquidity in the Peruvian economy. The second-degree polynomial is used to reflect the potential non-linearity in the relationship between foreign exposure and credit supply. We test the robustness of the results to alternative definitions of the instrument in Section 4.4.

4   Effect of Credit Supply Shock on Exports

In this section we use the methodology described above to estimate the elasticity of exports to credit on the intensive and extensive margins. Since our empirical strategy relies crucially on accounting for shocks to export productivity and demand, we define the margins of trade at the product-destination level. The intensive margin corresponds to firm export flows of a given product to a given destination, that were active both in the *Pre* and *Post* periods. The extensive margin corresponds to the probability that an exporting firm enters or exits a product-destination market. In the baseline specifications, we define products at the 4-digit level according to the Harmonized System (HS). As a result, our estimations are obtained from exports variation within close to 6,000 product-destinations.

Table 4 presents the decomposition of export growth during the *Pre* and *Post* periods along these margins. Export growth declined over 33 percentage points between the *Pre* and *Post* periods. Most of this decline is due to the change in the price of Peruvian exports. The decline in the growth of export volume was 12.8 percentage points. One third of this decline is explained by the drop in the intensive margin, and two thirds are explained by the reduction in the number of exporting firms within a product-destination market.

4.1   Intensive Margin of Exports

This subsection analyzes the effect of a credit supply shock on the *volume* of exports of firm-product-destination flows that are active in the two periods, $t = \{Pre, Post\}$. Export data are highly seasonal, so we collapse the panel into the two one-year periods to avoid estimation bias due to serial correlation and seasonality. The *Pre* and *Post* periods correspond to the 12 months before and after July 2008. Thus, X_{ipdt} corresponds to the sum of the volume of exports (in kilograms) of product p to destination d by firm i in the

period t, and C_{it} corresponds to the average outstanding debt balance (in local currency) of firm i in period t.

We estimate equation (3) by first-differencing to eliminate the firm-product-destination fixed effects. The resulting estimation equation is:

$$\ln\left(X_{ipdPost}\right) - \ln\left(X_{ipdPre}\right) = \alpha'_{pd} + \eta \cdot \left[\ln\left(C_{iPost}\right) - \ln\left(C_{iPre}\right)\right] + \varepsilon'_{ipd} \qquad (8)$$

The product-destination dummies, $\alpha'_{pd} = \alpha_{pdPost} - \alpha_{pdPre}$ in equation (3), absorb all demand fluctuations of product p in destination d. The supply of credit to firm i is instrumented with F_{it}, defined in equation (7). The first stage coefficients —i.e., a regression of credit of firms i at time t (C_{it}) on a second degree polynomial of the instrument (F_{it})– is shown in column 1. The coefficients on both polynomial terms are significant at the 1% level with a joint $F = 20.4$, which confirms that the instrument is correlated with the amount of credit.

The results of the Instrumental Variable (IV) estimation of the export elasticity to credit supply in specification (8) is presented in Table 5, column 3. The IV estimate implies that a 10% reduction in the stock of credit results in a decline of 1.8% in the volume of yearly export flows.

4.1.1 OLS Bias

The IV estimate of the export elasticity to finance is 6.8 times larger than the OLS estimate. The IV estimate corresponds to our model of interest: the supply-induced variation in exports —demand variation is absorbed by the product-destination dummies, α_{pd}— on variations in credit supply. The OLS estimate, however, corresponds to a regression of supply-induced variation in exports on *total* credit variation, induced by demand and supply factors. In the simplest scenario where credit demand and supply shocks are uncorrelated, credit demand variation is equivalent to measurement error and the OLS estimate

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is biased towards zero due to classical attenuation bias.

We can use the magnitude of the OLS bias to back out the relative importance of demand and supply determinants of credit. In our setting, the magnitude of the attenuation bias increases with the fraction of the total credit variation that is explained by credit demand factors. First-differencing further increases the magnitude of the attenuation bias when the independent variable (i.e., the supply of credit) exhibits serial correlation (see Arellano (2003)).

With no serial correlation in credit supply, demand variation must explain around 85% of the total variation in credit to obtain a bias of $\frac{\beta}{\beta_{OLS}}$ above 6.[20] In Monte-Carlo simulations (not shown) where we added serial correlation in credit supply through unobserved firm heterogeneity, we found that the OLS bias can be 7 to 10 times the IV estimate when demand explains 60% of the variation in total credit. This comparison suggests that supply side factors explain less than half of the variation in total credit during the crisis.

4.1.2 Heterogeneity across Export Flows

The intensive margin elasticity is estimated only for firm-product-destination flows that remained active during the Great Trade Collapse. We documented in Table 4 that there was substantial export exit during this period. In this subsection we address the question of whether the average elasticity of the intensive margin presented in Table 5 is also representative of those export flows that were discontinued during the crisis.[21] We follow the approach in Mulligan and Rubinstein (2008) and document the heterogeneity of the intensive margin elasticity for export flows with different probabilities of continuation.

We first estimate the probability that a firm-product-destination export flow that is

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[20]Using the classic measurement error bias formula, $\frac{\beta}{\beta_{OLS}} = 1 + \frac{\sigma^2_{demand}}{\sigma^2_{supply}} = 1 + \frac{.85}{.15} = 6.66$.

[21]Our intensive margin estimate is a Local Average Treatment Effect (LATE) for export flows that continue to be active during the crisis. We are interested in ascertaining whether this LATE estimate is an upper or a lower bound for the Average Treatment Effect for the population.

active in the *Pre* period continues active during the *Post* period ($\widehat{P}(X_{ipdPost} > 0|X_{ipdPre} > 0)$) using a Probit model with the following explanatory variables: the size of the export flow in the *Pre* period ($\log X_{ipd}$), the size of overall exports by the firm ($\log X_i$), the overall stock on credit ($\ln C_i$) and a second-degree polynomial on the measure of exposure, F_i defined in equation (6). The parameters of the Probit regression are reported on column 1 of Table 6, and indicate that larger export flows, and flows by larger firms with more credit are more likely to continue during the crisis.

Based on the Probit estimates of the probability of continuation for each flow, we estimate the intensive margin elasticity on subsamples that include only the export flows above the 20-th, 40-th, 60-th and 80-th percentiles of the continuation probability distribution. That is, subsamples defined by: $\left\{ ipd \mid \widehat{P}(X_{ipdPost} > 0|X_{ipdPre} > 0) \geq \alpha \right\}$ for $\alpha = 0.42, 0.56, 0.68, 0.79$.

The results are reported on columns 2 to 6 of Table 6. For comparison, the table also includes the sample defined by $\alpha = 0$, which corresponds to the full sample used in Table 5. The elasticity of the intensive margin of exports to credit is heterogeneous across export flows with different probability of continuation. It is higher for those export flows most likely to be discontinued (e.g. smaller export flows, and flows by firms with lower total exports and credit) and lower —even insignificant— for those export flows most likely to be active in the *Post* period. This result implies that the average intensive-margin elasticity in Table 5, computed over export flows that are active in both periods, is a lower bound of the elasticity that characterizes the universe of export flows.

4.2 Extensive Margin of Exports

We analyze the effect of a credit supply shock on the probability that an exporting firm abandons or enters a product-destination export market, by estimating equation (4).[22]

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[22]In an earlier version of this paper, we computed the effect of the credit shock on the *number* of entering and exiting export flows. The results were qualitatively similar: credit has a small but significant effect

As in the previous subsection, we collapse the time series into two periods, *Pre* and *Post*, which correspond to the 12 months before and after July 2008. There is a large number of intermittent export flows in the sample; thus, we consider a firm-product-destination flow to be active at time t if it registered positive exports at any time during those 12 months.

The definition of the sample of export flows at risk of exit is straightforward: it includes all firm-product-destination flows active in the *Pre* period. The definition of the potential entrants is less straightforward, because in principle any firm operating in Peru that is currently not exporting is a potential entrant. We adopt a narrower definition of potential entrants that includes only firms that are already exporting to any product-destination in the *Pre* period. The probability of entry is thus measured as the probability that an exporter enters a *new* product-destination market.[23]

Since entry and exit represent changes in the exporting status at the firm-product-destination level, we cannot first-difference equation (4) to eliminate the firm fixed-effect, δ_i. We therefore estimate the equation in levels, including the firm dummies that control for any time-invariant characteristic of the firm and product-destination-time dummies, α_{pdt}, that control for changes in demand, international prices, etc. Credit supply to firm i is instrumented with F_{it} defined in equation (7).

The results are presented in Table 5, columns 4 to 7. Only the exit margin reacts to changes in credit supply and the effect is economically small: A 10% reduction in the stock of credit results in an increase of 0.33 percentage points in the probability that a firms abandons a product-destination market.

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on the exit margin and a non-significant effect on entry.

[23]We also considered an alternative in which any firm with positive credit in the banking sector in the *Pre* period is a potential entrant. Using that definition of potential entrants, the estimated elasticity of entry to credit is also not statistically distinguishable from zero, but the precision of the estimate is very low.

4.3 Effect on Freight Characteristics and Trade Credit

Firms may adjust other dimensions of the trade activity when subject to a negative credit shock. In this subsection we explore the effect of a decline in the availability of bank funding on freight policies and the trade credit conditions with the importer. We estimate specifications parallel to (8) using the following left-hand side variables: (i) frequency of shipments for a firm-product-destination export flow during period t ($ShipFreq_{ipdt}$); (ii) average size of shipments (in volume) for a given export flow during the period t ($ShipVol_{ipdt}$); (iii) the fraction of the annual flow (value FOB) transported by air, as opposed to sea and ground, ($FracAir_{ipdt}$); and (iv) the fraction of the annual flow (value FOB) paid in advance by the importer ($FracCash_{ipdt}$).

The results are presented in Table 7. A negative shock to credit supply is found to reduce the frequency of shipments, with elasticity 0.11, significant at the 1% level (column 1). The elasticity of average shipment size, on the other hand, is not statistically significant (columns 2). These estimates suggest the existence of fixed costs of exporting at the shipment level. A large per-shipment fixed cost is consistent with the frequency of shipments being more elastic to a credit shock than their size.

Holding the product and the destination constant, firms do not increase the share of exports shipped by air (as opposed to sea or ground) after a negative credit shock (column 3). Finally, the fraction of the transaction value paid in advance by the importer is sensitive to the decline in credit supply (column 4). That is, the exporters partially substitute bank credit with trade credit by the importer. However, the magnitude of the effect is economically small: A 10% reduction in bank lending triggers an increase of 0.33% in the fraction of the shipment paid in advanced by the importer. This is consistent with the findings in Antras and Foley (2011), who document stickiness in the terms of the trade credit contracts between established trade partners during the 2008 financial crisis.

4.4 Identification and Robustness Tests

As mentioned in Section 3, the elasticity estimates will be biased if firms associated with banks with high foreign liabilities experience a disproportionate negative shock to exports relative to other firms exporting to the same product-destination for reasons other than bank credit. This could occur, for example, if firms that borrow from exposed banks export products of a higher quality (within the same 4 digit HS code), and the demand for higher quality products dropped more during the crisis. It would also occur if firms with high foreign currency denominated liabilities borrow from banks with high foreign liabilities, and the capital flow reversals affect the balance sheet of firms directly and not through bank lending. In this section we perform identification tests to account for potential shocks correlated with bank affiliation.

In the first identification test we estimate the export elasticity in the intensive margin measuring exports in dollar FOB values. If the identification assumption is violated because there are demand or input price changes within-product-destination markets that are correlated with bank affiliation, these changes should be reflected in prices and, as a result, the elasticities measured in export volumes should be different than the elasticities measured in values. On the contrary, if price changes faced by firms exporting to the same market are orthogonal to their bank affiliation, then the product-destination dummies should absorb these effects resulting in the same estimates of export elasticities if measured in volume or value. The result in Panel 1 in Table 8 confirms that the volume and value elasticities are of the same order of magnitude and statistically indistinguishable.

Next, we test whether narrowing the definition of an export market or whether considering only homogeneous goods changes our elasticity estimates. In Panel 2 the export elasticity to credit when products are aggregated at the 6 digit level, according to the HS code. This specification controls for shocks in 8,568 distinct product-destination markets, reducing the scope for quality difference within each market. In Panel 3, we restrict the

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sample to export flows of *homogenous* goods only, according to the product classification in Rauch (1999). These goods are considered to be less differentiated in terms of quality and other potential unobservable characteristics. In both cases, the elasticities of the intensive and extensive margins are statistically identical to those in the baseline regression.

An alternative way to test for unaccounted shocks correlated with bank affiliation is to explicitly control for them. In the fourth identification test we augment equation (8) with a set of observable firm and export flow characteristics in the *Pre* period as control variables: Average unit price of exports at the firm-product-destination level, average fraction of debt denominated in foreign currency, total exports, number of products, and number of destinations at the firm level. Including these pre-determined variables in the first differenced specification is equivalent to including them interacted with time dummies in the panel specification of equation (3). Thus, this augmented specification controls for heterogeneity in the evolution of exports after the crisis along the product quality (high unit price within a 4-digit HS classification), firm external exposure, and firm size dimensions. The elasticity of the intensive margin is statistically indistinguishable of the baseline regression. The elasticity of the exit margin, although similar in magnitude, drops in significance in this specification (Panel 4, Table 8).

In Panel 5 we expand the *Post*-period to include 24 months after the capital flow reversal in July 2008. Our results are magnified when we expand the time horizon: The elasticities on the intensive and exit margins are larger than in the baseline regressions. This suggests that the credit shock has long lasting effects on firms' real outcomes. The expansion of the *Post*-period does not alter our results with respect to the entry margin. It is still not significantly affected by the credit supply shock.

In Panels 6 and 7 we test the robustness of the results to the definition of the instrument. We verify that the results are not sensitive to the date in which we measure the

share of foreign liabilities of the banks or the firm composition of credit across banks. In our baseline regressions, we define this measures according to figures of December 2006, prior to the reversal of capital flows. In Panel 5, the instrument is defined according to banks and firms figures of December 2007, at the peak of the foreign capital inflows. In Panel 6 we alter the functional form of the instrumental variable. Credit is instrumented with a firm level dummy that is equal to one if the firm borrows more than 50% from banks with share of foreign liabilities above 10%, the mean exposure among commercial banks. In all cases, the elasticities are statistically undistinguishable from the baseline results in Table 5, although the significance of the extensive margin elasticities changes (the entry elasticity becomes significant at the 10% level and the exit elasticity becomes insignificant). The independence of the estimate from the exact measure of bank exposure to foreign liabilities indicates that the magnitude of the elasticity is not correlated with bank affiliation.

Finally, we explore the possibility that firms associated with exposed banks were simply on a different export and borrowing growth path before the crisis. If this were the case, our estimates could be capturing such pre-existing differences across the two groups of firms and not the effect of the credit shock. We perform the following placebo test: we estimate equations (8) and (4) lagging the debt and export measures one year, as if the capital flow reversals had occurred in 2007 instead of 2008. That is, for $t = \{Pre-1, Pre\}$, where Pre is, as above, the period July 2007-July 2008, and $Pre - 1$ corresponds to the previous 12 months. The elasticities of both the intensive and extensive margin of exports, reported in Panel 7 of Table 8, are not statistically different from zero. This confirms that firms borrowing from banks with a high share of foreign liabilities as of December 2007 did not face any differential credit supply prior to the crisis. And, correspondingly, their exports performance was not different from those of firms linked to banks with a low share of foreign liabilities.

Overall, the results in in this section suggest that our empirical approach obtains unbiased estimated of the elasticity of exports to credit. In other words, after conditioning on product-destination shocks to exports, a firm's affiliation to a bank with a high share of foreign liabilities is orthogonal to other non-credit determinants of exports.

4.5   Discussion of the Results

Overall our results are consistent with models of heterogeneous firms —as in Melitz (2003)— expanded to allow for multi-product output and exports, as in Bernard et al. (2011) and Nocke and Yeaple (2012). A firm decides to export a product to a destination if the corresponding sales cover the fixed cost of exporting.

In this class of models, a shock that affects the variable cost of production can generate all our results: (i) a drop in the intensive margin of trade in all those firm-product-destination flows that continue active; (ii) given the existence of a fixed cost of exporting, a shock to the variable cost of production will affect the exit decision for those product-destination export flows that are small enough to be near the cutting point. In other words, our results are consistent with credit shocks affecting the *variable* cost of production, as modeled in Feenstra et al. (2011). This is the case, for example, if the credit shock implies an increase in the cost of external finance needed to pay inputs in advance of receiving the revenues from production. Similar results can also arise if the credit shock affects the variable cost of exporting beyond that of production; however, we show in Subsection 5.2 that we do not find evidence supporting this interpretation.

Our results suggest that the fixed cost of exporting is at the shipment level, that is why the frequency of shipments adjust together with quantities exported, after a credit shock, while the size of each shipment stays fairly constant. On the other hand, our results are not consistent with models where credit is *only* used to pay the entry or fixed cost of exporting as in Chaney (2005), Manova (2013), and Caggese and Cuñat (2012) or

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to pay fixed capital investment as in Brooks and Dovis (2012) and Leibovici (2013). In those models, credit shocks only affect the entry decision but not the intensive margin of trade. Needless to say, our results do not imply those credit motives are not present. They point at two different usages of credit, the finance of working capital of production and the funding of physical investment.

The fact that credit conditions affect the variable cost of production, rather than only fixed investment or entry cost, imply that short-lived credit shocks can have large real economic consequences. This is because capital is a stock variable and it does not substantially vary with short-lived shocks. Similarly, in the specific case of international trade, exports are very skewed towards existing large exporters. Aggregate exports are hardly affected by the exit or entry of firms into export markets, as these marginal export flows are typically relatively small. Changes in the cost of credit for working capital, on the other hand, affect the quantities produced and exported instantaneously. Moreover, they affect both large and small firms. This is why macroeconomic models aimed at studying the dynamic consequences of this type of shocks often include working capital in the production function (see, for example, Neumeyer and Perri (2005)).

5   Assessment of Alternative Empirical Approaches

Our empirical strategy requires detailed and disaggregated data typically not available in the literature aimed at measuring the effect of credit shocks on real economic activity. In the absence of this type of data, researchers has had to rely on a series of ad hoc, and up to now untested, identification assumptions. The data and empirical strategy in this paper allow us to test several of the key assumptions in existing empirical work. First, we estimate the bias that would arise in our environment if we could not account for the selection of firms to banks in terms of their mix of products and destinations. Second, we analyze whether those variables typically used as proxy for export-specific funding needs

are indeed predictors of the elasticity of exports to credit shocks. And finally, we explore the validity of the measure of external finance dependence, an the industry-level indicator often used in this literature, as a proxy for sensitivity of output to credit.

5.1 Firm-Bank Selection

Most of the work studying real effects of the bank transmission channel is constrained to the analysis of firm level outcomes, such as total sales, total exports, employment or investment (see for example Amiti and Weinstein (2011), Carvalho et al. (2010), Iyer et al. (2010), Jimenez, Mian, Peydro and Saurina (2011), Kalemli-Ozcan et al. (2010), and Chodorow-Reich (2013)). The typical empirical strategy compares outcomes of firms related to banks that are differentially affected by the crisis, and implicitly assumes that banks and firms are randomly matched. If, on the contrary, firms related to exposed banks specialize in certain products or markets that are particularly affected by the crisis, then estimates based on comparing the outcomes of firms related to exposed and non exposed banks confound the effect of the lending channel with the heterogeneous impact of the crisis across markets.

We compute the bias that arises in our setting when we do not account for shocks at the product-destination level. Table 9, column 1, presents the naive estimation of the elasticity of exports (intensive margin) to credit, without including the product-destination dummies. The naive estimator misses by an order of magnitude the elasticity of credit supply on exports (our baseline estimate is shown in column 2 for comparison). This implies that firms and banks are not randomly matched. In particular, in this case, firms borrowing from exposed banks specialize in products and destinations less affected by the international crisis.[24] Thus, when non-finance shocks at the product-destination level are unaccounted for, the overall importance of credit shocks in explaining output fluctuations

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[24]The bias is largest when there are no controls for changes in export demand across destination markets.

can be severely misestimated. In the present case, the bias would lead to conclude erroneously that the negative credit shocks did not contribute to the Peruvian exports decline during the Great Trade Collapse.

5.2 Export-Specific Funding Needs

Substantial fixed exporting costs can make exports more sensitive to credit than domestic sales, as changes in the exporter's availability of credit may trigger discontinuous changes in exports. Furthermore, international trade is characterized by longer freight times and, thus, longer cash cycles than domestic sales. Based on this intuition, the empirical literature uses distance to destination and freight speed (ground and sea versus air) as indicators of export-specific working capital (see for example Amiti and Weinstein (2011), Leibovici and Waugh (2013), and Berman et al. (2012)). In order to estimate export-specific credit sensitivity, this approach compares the impact of credit on export flows across destinations of heterogeneous distance or across products typically shipped using by different modes of transportation.

The results in the previous subsection already call for caution when deriving conclusions regarding the importance of credit in explaining output fluctuations based on comparisons across sectors or destinations, because products and countries are subject to different non-credit disturbances. This empirical strategy confounds trade-specific sensitivity to credit with non-credit shocks affecting disproportionately certain products or destinations. To further characterize the potential biases in such comparisons, we present in Table 9, columns 3 through 8, cross-sectional differences in the estimated elasticities by distance to the export destination market ($Dist_d$), the share of the export flow shipped by air, as opposed to ground and sea (Air_{ipd}), and the share of the export flow paid in advance by the importer ($Cash_{ipd}$), with and without accounting for product-destination shocks. The variables $Dist_d$, Air_{ipd}, and $Cash_{ipd}$ are standardized Pre period values such

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that the interaction coefficients can be interpreted as changes in the elasticity for a one standard deviation change in distance to destination, fraction of air freight and fraction of cash in advance, respectively.

Two main observations can be drawn from this exercise. First, the elasticity estimates accounting for product-destination shocks do not vary in the cross section by distance, freight method, or method of payment (columns 4, 6, and 8). This indicates that the difference in working capital requirements induced by heterogeneity along these export dimensions does not have a first order effect on the export elasticity to credit. Since we do not have data on domestic sales we cannot conclusively compare the credit elasticity of exports and local sales. Still, we can confirm that the sensitivity of exports to credit shocks does not vary significantly with variables that typically proxy for trade-specific financial needs.

The second observation is that when product-destination shocks are not accounted for, the interaction terms for method of payment and freight method become large and statistically significant (the interaction with distance remains insignificant). Hence, the estimates would erroneously suggest that the sensitivity of exports to credit shocks increases if the export flow is mostly shipped by ground or sea (column 5), or if the export flow is paid in advance by the importer (column 7). This analysis confirms that empirical approaches based on cross-destination and cross-sector comparisons may lead to incorrect inferences about the real effects of credit shocks when demand factors are unaccounted for. Moreover, the bias of the naive cross sectional comparisons highlights that the mode of payment and transportation are intimately linked with the nature of good exported. Firms that specialized in products typically shipped by *Air* (presumably more expensive), and firms that provided more trade credit to importers (presumably longer relationships with more established customers) were disproportionately affected during the crisis for non-credit related reasons.

5.3 Sectorial Heterogeneity in Credit Intensity

Since the seminal work by Rajan and Zingales (1998), heterogeneity in the degree of external finance dependence across sectors has been widely used to identify the effect of credit constraints on long-term growth and the cross country pattern of international trade.[25] It remains to be shown whether the same factors that affect the sensitivity of exports to long-term finance can also predict the effect of short-term credit shocks. This subsection explores this question.

We analyze how our estimates of the export elasticities to credit shocks vary across sectors with different external finance dependence. Our measure of external finance dependence follows Chor and Manova (2010); it corresponds to the fraction of total capital expenditure not financed by internal cash flows based on cross sectoral data of U.S. firms. This measure is considered to represent technological characteristics of the sector the firm belongs to. For example, according to this measure, *textile mills* that transform basic fibers into fabric, intensively require external finance, while *apparel manufacturing* firms that process that fabric into the final piece of clothing, are considered to be less dependent.

We report in Table 10 the results of estimating the sensitivity to credit of the intensive and extensive margins of export in equations (8) and (4), augmented with an interaction with the (standardized) product's external financial dependence. The probability of entry is more sensitive to credit shocks for those sectors highly dependent on external finance (column 3). The elasticities of the intensive and exit margins, on the other hand, do not vary with this measure (columns 1 and 2).

Our results suggest that the elasticities to short-term and long-term changes in financial conditions capture different aspects of the firm's use of credit. The measure of external finance dependence may indicate the sensitivity of the firm to long term credit conditions, which is potentially related to the presence of important fixed investments

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[25]See, for example, Bricongne et al. (2009), Chor and Manova (2010), and Levchenko et al. (2010).

or entry costs. The elasticity of the intensive margin of exports to credit shocks, on the other hand, appears to be related to the short term needs of working capital.

6 Conclusions

We use the estimated elasticities to perform a *back of the envelope* calculation of the contribution of finance to the overall export decline during the the 2008 crisis. Our estimates are obtained from changes in credit according to the level of foreign exposure of commercial banks. Thus, to obtain a back of the envelope calculation of the overall effect of the credit shock to firms on the total exports decline we must make an assumption about the change in credit supply of non-exposed banks —i.e. banks with no foreign liabilities. We make the simplifying assumption that credit supply of non-exposed banks is constant throughout the analysis period. This assumption produces conservative estimates of the overall effect of credit if non-exposed banks also reduced credit supply during the crisis. The contrary occurs if non-exposed banks expanded credit supply to substitute for the unfulfilled demand by banks with higher share of foreign liabilities.

The estimates in Table 3 imply that a 1 percentage point increase in the share of foreign liabilities resulted in a reduction in credit supply of 2.34%. The average share of banks' foreign liabilities, weighted by their participation in the total lending to exporting firms, is 4.1% (see Table 2). Given the above assumption, these estimates imply that total credit supply dropped by 9.6%. Using the estimated intensive and exit margin elasticities of 0.179 and -0.033 (see Table 5), this drop in credit resulted in an average drop in the volume of exports of 2%. Compared to the total drop in the annual growth rate of the volume of exports between the *Pre* and *Post* periods, 12.8 percentage points (see Table 4), this estimate implies that the credit shock can account for approximately 16% of the missing volume of trade.

Overall, the results in this paper show that credit has a first order effect on the volume

of exports. However, the largest determinant of the Peruvian exports collapse during the 2008 crisis is related to non-credit factors (e.g., international demand and prices). In our context, failure to control for determinants of exports other than bank credit at the product-destination level leads to severely biased estimates when studying the effect of a credit contraction on trade. Our results suggest that estimates that rely on more aggregated data (e.g., outcomes at the firm or sector levels) should be interpreted with caution during crisis episodes, which have potentially large and heterogeneous real effects across sectors and countries.

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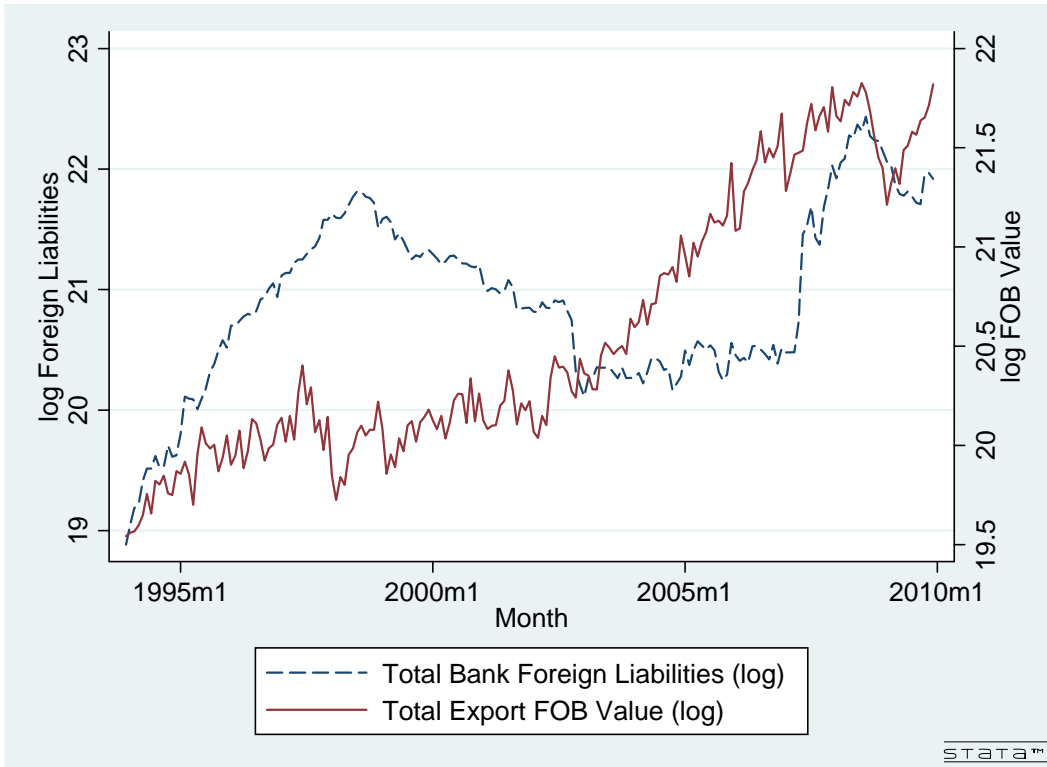
Note: Value of exports in dollars FOB (Source: SUNAT) and bank liabilities with institutions outside Peru (Source: Superintendencia de Bancos y Seguros de Peru)

Figure 1: Total Peruvian Exports

	All Financial Institutions (N=41)			High Foreign Exposure Banks (N=4)			Low Foreign Exposure Banks (N=9)			Cajas and Microfinance (N=28)		
	mean	sd	p50	mean	sd	p50	mean	sd	p50	mean	sd	p50
Assets (M US$)	1,102	2,744	134	2,533	3,817	794	3,559	4,568	1,023	108	108	62
Loans (M US$)	598	1,503	105	1,709	2,575	562	1,705	2,422	711	84	86	46
Deposits (M US$)	4,510	11,061	189	1,681	2,682	436	2,642	3,391	750	65	71	36
Loans/Assets	0.698	0.178	0.756	0.659	0.126	0.660	0.582	0.189	0.601	0.741	0.167	0.773
Deposits/Assets	0.586	0.197	0.642	0.573	0.082	0.543	0.696	0.147	0.735	0.553	0.212	0.621
Foreign Financing/Assets	0.055	0.108	0.002	0.196	0.135	0.175	0.050	0.034	0.065	0.037	0.108	0.000

Source: Bank financial statements as of December 2007, Superintendencia de Bancos y Seguros de Peru.

Table 1: Commercial Bank Descriptive Statistics

	All Exporters			Full Subsample (Positive Debt after June 2008)		
	mean	sd	p50	mean	sd	p50
Panel 1. Firm	(N = 6,169)			(N=4,974)		
Debt (1,000 US$)	1,013	6,903	1.45	1,253	7,668	9.58
# of Lenders	1.70	1.10	1.10	1.75	1.12	1.19
Fraction of Debt in Foreign Currency	0.708	0.385	0.951	0.713	0.381	0.953
Exports - FOB (1,000 US$)	3,348	52,721	28	4,005	58,478	31
Exports (1,000 Kg)	8,466	230,071	11	10,371	256,182	12
# destinations	2.7	4.3	1.0	2.9	4.5	1.0
# products (4-digit)	5.3	9.4	2.0	4.7	8.2	2.0
# Product x Destinations	8.7	20.4	3.0	8.0	18.5	3.0
Over 50% Debt from Exposed Bank (dummy)	0.248	0.432	0.000	0.296	0.456	0.000
Share foreign liability weighted by firm's debt	0.037	0.036	0.032	0.041	0.036	0.043
Panel 2. Firm-Product-Destination	(N = 53,690)			(N=47,810)		
Value - FOB (1,000 US$)	169.3	3,675.6	0.7	184.8	3,875.5	0.8
Volume (1,000 Kg)	401.7	22,112.8	0.1	446.4	23,432.3	0.1
Distance (km)	6,521	7,696	5,587	6,518	8,005	5,587
Paid in advance (FOB 1,000 US$)	42.2	1,764.5	0.0	46.3	1,869.6	0.0
Transported by Air (FOB 1,000 US$)	37.2	2,181.9	0.0	40.8	2,311.6	0.0
Shipment Value - FOB (1,000 US$)	32.8	470.2	0.5	36.0	497.1	0.5
Shipment Volume - (1,000 Kg)	77.5	2,203.1	0.1	86.1	2,334.4	0.1
# Shipments per year	2.23	2.19	1.00	2.17	2.15	1.00

Source: Customs data from SUNAT, credit registry data from the Superintendencia de Bancos y Seguros de Peru. Sample: firms with at least one export registered between July 2007 and June 2009. The statistics are estimated over the calendar year July 2007-June 2008.

Table 2: Firm Descriptive Statistics

Dependent Variable	$\Delta \ln D_{ib}$					
	All Debt		US Dollar Denominated		Soles Denominated	
	(1)	(2)	(3)	(4)	(5)	(6)
FD_b	-2.344**		-3.255**		2.852*	
	(1.105)		(1.285)		(1.431)	
$S\&L_b$	-0.331***		-0.644**		0.125	
	(0.120)		(0.256)		(0.205)	
$D(FB_b > 10\%)$		-0.168***		-0.241***		0.161**
		(0.046)		(0.047)		(0.076)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,334	10,334	8,433	8,433	6,515	6,515
R^2	0.630	0.630	0.634	0.634	0.651	0.650
R^2 adj	0.261	0.261	0.250	0.263	0.102	0.102
# banks	41	41	33	33	39	39
# firms	5154	5154	4320	4320	3977	3977

Estimation of equation (5). FD_b is the share of foreign liabilities of bank b. $D(FD_b > \overline{FD})$ is a dummy that signals whether foreign liabilities of bank b is above the mean. Robust standard errors, clustered at the bank level, in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 3: Transmission of Credit Shocks by Commercial Banks with High Foreign Dependence

	Value(FOB)			Volume (kg)		
	t=Pre	t=Post	Diff	t=Pre	t=Post	Diff
Total	10.9%	-22.4%	-33.3%	3.2%	-9.6%	-12.8%
Intensive	10.6%	-15.7%	-26.3%	2.1%	-2.2%	-4.3%
Extensive	0.3%	-6.6%	-6.9%	1.2%	-7.4%	-8.6%
Entry	8.4%	8.2%	-0.2%	8.6%	8.3%	-0.3%
Exit	-8.1%	-14.8%	-6.7%	-7.4%	-15.7%	-8.3%

Source: SUNAT. Extensive and intensive margins defined at the level of product destination flows. For each $t = \{Pre, Post\}$, it corresponds to the growth rate $X_t/X_{t-1} - 1$. Each time t is a 12 months period and Pre and $Post$ periods correspond to the 12 months before and after July 2008. A flow firm-product-destination is considered active at time t if exports were positive at any time during the period. Product definition aggregated at 4-digit level according to the Harmonized System.

Table 4: Descriptive Statistics of Export Growth

Dependent Variable	$\Delta \ln C_i$	$\Delta \ln X_{ipd}$ Intensive		$\Pr(X_{ipdt}=0\|X_{ipdt-1}>0)$ Exit		$\Pr(X_{ipdt}>0\|X_{ipdt-1}=0)$ Entry	
	FS (1)	OLS (2)	IV (3)	OLS (4)	IV (5)	OLS (6)	IV (7)
F_i	8.336***						
	(3.169)						
F_i^2	-119.976***						
	(24.931)						
$\Delta \ln C_i$		0.025**	0.179**	-0.001	-0.033*	0.007	-0.006
		(0.010)	(0.071)	(0.003)	(0.017)	(0.000)	(0.016)
Prod-Dest FE	Yes	Yes	Yes	No	No	No	No
Prod-Dest-Time FE	No	No	No	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes	Yes
Obs	14,208	14,208	14,208	62,386	62,386	61,909	61,909
R^2	0.358	0.438		0.591		0.600	

Estimation of equations (8) and (4). In the IV regression, the change in (log of) credit, $\Delta \ln C_i$, is instrumented with the measure of exposure $F_i = \sum_b \omega_{ib} FB_b$, where ω_{ib} is the share of bank b in overall credit of firm i and FB_b is the share of foreign liability of bank b. Standard errors clustered at the product-destination level in parenthesis. ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$

Table 5: Export Elasticity to Credit Shocks

Dep. Variable	$Pr(X_{ipdPost} > 0 \mid X_{ipdPre} > 0)$	$\Delta \log(X_{ipd})$				
	Probit (1)	$Pr > 0$ (2)	$Pr > 0.42$ (3)	$Pr > 0.56$ (4)	$Pr > .68$ (5)	$Pr > .79$ (6)
$\Delta \ln C_i$		0.179**	0.210**	0.242**	0.146	0.028
		(0.071)	(0.085)	(0.121)	(0.129)	(0.105)
$\log X_{ipd}$	0.145***					
	(0.003)					
$\log X_i$	0.040***					
	(0.004)					
$\ln C_i$	0.018***					
	(0.002)					
F_i	0.886					
	(0.770)					
F_i^2	-2.745					
	(5.845)					
Prod-Dest FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,763	14,208	10,708	8,031	5,354	2,677
R^2	0.166					

The dependent variable in the Probit regression is the probability of continuation in *Post*-period for a firm-product-destination export flow active in the *Pre*-period (column 1). Columns 2 to 6 correspond to IV estimation of equation (8), restricting the sample to those flows with probability higher than the indicated threshold, which correspond to 0, 20, 40, 60, and 80 percentiles of the distribution of continuation. Change in (log of) credit, $\Delta \ln C_i$, is instrumented with $F_i = \sum_b \omega_{ib} F B_b$, where ω_{ib} is the share of bank b in overall credit of firm i and FB_b is the share of foreign liability of bank b. ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$

Table 6: Heterogeneity of the Export Elasticity to Credit

Dependent Variable	$\Delta \ln(ShipFreq_{ipd})$	$\Delta \ln(ShipVol_{ipd})$	$\Delta \ln(FracAir_{ipd})$	$\Delta \ln(FracCash_{ipd})$
	(1)	(2)	(3)	(4)
$\Delta \ln(C_i)$	0.108***	0.071	0.004	-0.033*
	(0.032)	(0.057)	(0.011)	(0.018)
Product-Dest FE	Yes	Yes	Yes	Yes
Observations	14,208	14,208	14,208	14,208

IV estimation of equation (8). Dependent variable in column 1 is the (log of) frequency of shipments; in column 2 is the (log of) average size of shipments (in volume); in columns 3 and 4, it is the change in the fraction of annual export flows (FOB) transported by air and paid in advanced by the importer, respectively. Change in (log of) credit, $\Delta \ln C_i$, is instrumented with $F_i = \sum_b \omega_{ib} FB_b$, where ω_{ib} is the share of bank b in overall credit of firm i and FB_b is the share of foreign liability of bank b. ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$

Table 7: Effect of Credit on Export Arrangements

Dep. Variable	$\Delta \ln X_{ipd}$ Intensive (1)	$\Pr(X_{ipdt} > 0 \mid X_{ipdt-1} = 0)$ Entry (2)	$\Pr(X_{ipdt} = 0 \mid X_{ipdt-1} > 0)$ Exit (3)
Panel 1:	X_{ipd} is Value (FOB) of Exports		
$\Delta \ln C_i$	0.239***	–	–
	(0.072)		
Panel 2:	Product Classification at 6 HS digits		
$\Delta \ln C_i$	0.250***	-0.009	-0.035***
	(0.055)	(0.015)	(0.013)
Panel 3:	Sample of Homogeneous Goods		
$\Delta \ln C_i$	0.154**	-0.016	-0.042**
	(0.072)	(0.017)	(0.018)
Panel 4:	Controlling for Observable Firm Characteristics		
$\Delta \ln C_i$	0.140**	-0.016	-0.026
	(0.069)	(0.016)	(0.017)
$\ln X_i$	-0.052***	0.006	-0.021***
	(0.013)	(0.005)	(0.006)
ln dollar debt	0.010	-0.060***	-0.048**
	(0.022)	(0.022)	(0.019)
unit price	0.058**		0.000
	(0.029)		(0.000)
ln # products	0.116*	-0.048***	0.114***
	(0.067)	(0.008)	(0.010)
ln # destinations	0.000	0.021	0.088***
	(0.000)	(0.019)	(0.016)
Panel 5:	*Post*-period of two years		
$\Delta \ln C_i$	0.272***	-0.005	-0.053***
	(0.051)	(0.011)	(0.016)
Panel 6:	Measure of Exposure as of December 2007		
$\Delta \ln C_i$	0.203**	-0.001	-0.027**
	(0.077)	(0.012)	(0.012)
Panel 7:	Alternative IV functional form (dummy)		
$\Delta \ln C_i$	0.227***	0.018*	-0.013
	(0.066)	(0.011)	(0.015)
Panel 8:	Placebo Test		
$\Delta \ln C_i$	-0.009	-0.077	-0.048
	(0.075)	(0.057)	(0.041)

IV estimations of (8) and (4). Panel 1: exports measured in US\$ FOB. Panel 2: products aggregated at 6-digit level (Harmonized System). Panel 3: restricts sample to homogeneous goods as defined in Rauch (1999). Panel 4: adds controls for overall volume of export, fraction of dollar debt, unit price of exports, # products exported, and # destinations. Panel 5: *Post*-period includes 24 moths after July 2008. Panel 6: foreign liabilities of banks and share of firm's credit with each bank correspond to Dec 2007. Panel 7: $\Delta \ln C_i$ instrumented with a dummy equal to one if the firm borrows more than 50% from banks with a share of foreign liabilities above the mean. Panel 8: placebo test assuming that the credit shock occurred a year earlier (June 2006). Standard errors clustered at the product-destination level in parenthesis. ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$

Table 8: Identification Tests

Dependent Variable	ΔX_{ipd}							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \ln C_i$	0.012	0.179**	0.002	0.191**	0.028	0.156***	0.086	0.237***
	(0.067)	(0.071)	(0.066)	(0.080)	(0.058)	(0.060)	(0.060)	(0.061)
$\Delta \ln C_i \times dist_d$			-0.006	-0.033				
			(0.023)	(0.064)				
$\Delta \ln C_i \times Air_{ipd}$					-0.132***	-0.075		
					(0.039)	(0.056)		
$\Delta \ln C_i \times Cash_{ipd}$							0.056*	0.012
							(0.033)	(0.040)
Prod-Dest FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	14,208	14,208	14,146	14,146	14,208	14,208	14,208	14,208

IV estimations of equation (8). The instrument F_i is $\sum_b \omega_{ib} FB_b$, where ω_{ib} is the share of bank b in overall credit of firm i and FB_b is the share of foreign liability of bank b. Credit is interacted with the following (standardized) variables: distance to market of destination ($dist_d$), an indicator on whether the export flow was shipped by air (Air_{ipd}), and the fraction of the transaction payed in advanced by the importer ($Cash_{ipd}$). Standard errors clustered at the product-destination level in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 9: Estimation Bias

Dependent Variable	Intensive Margin	Extensive Margin	
	ΔX_{ipd}	$\Pr(X_{ipdt} = 0 \mid X_{ipdt-1} > 0)$	$\Pr(X_{ipdt} > 0 \mid X_{ipdt-1} = 0)$
	(1)	(2)	(3)
$\Delta \ln C_i$	0.145**	-0.032*	-0.008
	(0.070)	(0.018)	(0.017)
$\Delta \ln C_i \times HighFinDep_p$	-0.109	0.005	0.012***
	(0.082)	(0.004)	(0.004)
Product-Destination FE	Yes	No	No
Product-Destination-Time FE	No	Yes	Yes
Firm FE	No	Yes	Yes
Observations	14,208	56,215	56,179

IV estimation of equations (8) and (4). The (log of) credit, $\ln C_i$, is instrumented with $F_i = \sum_b \omega_{ib} FB_b$, where ω_{ib} is the share of bank b in overall credit of firm i and FB_b is the share of foreign liability of bank b. The classification of sectors according to their dependence of external finance follows Chor and Manova (2010). Standard errors clustered at the product-destination level in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 10: Elasticity by Product Characteristic