Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit-Export Data *

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Abstract

In this paper we estimate the elasticity of exports to credit shocks. As a source of variation, we exploit the disproportionate reduction in credit supply by banks with high share of foreign liabilities during the 2008 financial crisis. Using matched customs and firm-level bank credit data from Peru, we compare changes in exports of the *same* product and to the *same* destination by firms borrowing from different banks, which allows us to account for variation in non-credit determinants of exports. On the intensive margin, the elasticity of exports to credit is 0.23, and it is relatively constant across firms of different size, industry, and other observable characteristics. We find that both the frequency and average size of shipments are sensitive to credit shocks. On the extensive margin, the elasticity of the number of firms that continue supplying a product-destination export market is 0.36, but credit has no effect on the number of entrants. The estimated elasticities imply that the negative credit supply shock accounts for 15% of the drop in Peruvian exports during the financial crisis.

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1 Introduction

The role of banks in the amplification of real economic fluctuations has been debated by policymakers and academics since the Great Depression. The basic premise is that, due to information frictions in capital markets, the deterioration of bank balance sheets during economic downturns increases the real cost of financial intermediation, which in turn reduces credit and output (Friedman and Schwarz (1963), Bernanke (1983)). Motivated by the unprecedented drop in world exports during the subprime financial crisis, this debate has permeated to the international trade literature. Do shocks to the balance sheet of banks affect export performance of related firms? What is the sensitivity of exports to changes in the supply of credit? How do credit fluctuations distort the entry, exit, and quantity choices of exporters?

In this paper we address these questions by analyzing the role played by commercial banks in the international transmission of the 2008 financial crisis to Peruvian exports. Peru is an ideal country for studying the consequences of a credit supply shock on trade for three reasons. First, although local firms were not directly affected by the drop in the value of U.S. real estate, domestic banks' balance sheets were negatively affected by the reversal of capital flows, especially those with high share of foreign liabilities. Second, as a small open economy, one can abstract from general equilibrium effects on international demand or prices. And lastly, we can match firm level Credit Registry data with publicly available customs data on the universe of peruvian exports. The main novelty of these data is that they allow us to estimate an elasticity of exports to credit and decompose it along the intensive and extensive margins.

The key empirical challenge is to disentangle the effect of credit supply on trade from changes in credit demand in response to factors affecting exports, such as economic conditions in destination countries or the cost of export production. To address this identification problem, we exploit the detail of the customs data to compare the export growth of the *same* product and to the *same* destination by firms that borrow from banks with different shares of foreign liabilities. Banks that had a high share of foreign liabilities before the financial crisis suffered a large negative funding shock when capital flows reversed during 2008. We demonstrate, using

the within firm estimator in Khwaja and Mian (2008), that the supply of credit by these banks declined by 17% after July 2008. We use the heterogeneity in banks' foreign liabilities as source of variation in the supply of credit to related firms to estimate the export elasticity to credit.

To illustrate the intuition behind our empirical strategy consider, for example, two firms that export *Men's Cotton Overcoats* to the *U.S.*.[1] Suppose that one of the firms obtains all its credit from Bank A, which had a large share of foreign liabilities before the crisis, while the other firm obtains its credit from Bank B, which did not. Changes in the demand of overcoats 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, i.e., changes in the price of cotton, should affect both firms' exports the same way. Thus, the change in export performance of a firm that borrows from Bank A relative to a firm that borrows from Bank B provides an estimate of the effect of the decline in the supply of credit on exports.[2]

Using an instrumental variable approach based on this intuition, we estimate the credit elasticity of the intensive and extensive margins of export. On the intensive margin, we find that a 1% reduction in the supply of credit results in a contraction of 0.23% in the volume of export flows for those firm-product-destination flows active before and after the crisis. This elasticity does not vary with the size of the exporter or the export flow. Firms adjust the intensive margin of exports by altering, both, the size and frequency of shipments. The elasticities of the frequency and size of shipments to credit are 0.14 and 0.11, respectively. On the extensive margin, credit supply affects the number of firms that continue exporting to a given market, with elasticity of 0.36. This effect is particularly important for small export flows: a 1% decline in the supply of credit reduces the number of exporting firms exporting to a product-destination

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

[2] Controlling for factors other than finance that affect exports at the product-destination level is particularly important during an international crisis, which has potentially large and heterogeneous real effects across sectors and countries. See, for example, Alessandria, Kaboski and Midrigan (2010), who focus on the role of inventories in the amplification of export fluctuations, Bems, Johnson and Yi (2010) and Levchenko, Lewis and Tesar (2010), who analyze the role of intermediate goods and vertical linkages, and Eaton, Jonathan and Kortum, Sam and Neiman, Brent and Romalis, John (2010), who find that world trade collapse can be explained mainly by real factors. We show that not accounting for such variation results in overestimating the elasticity of exports to credit by up to 65% in our setting.

by 0.54%, if the initial export flow volume was below the median. The credit shock does not affect significantly the number of firms entering an export market.

We use the estimated elasticities to assess the importance of the credit shortage in explaining the decline in Peruvian exports during the crisis. The volume of Peruvian exports dropped 9.6% (22% in value) during the year following July 2008, a decline of almost 13 percentage points with respect to the previous year (see Figure 1). 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. Thus, bank credit appears to have a first order effect on trade, but the bulk of the decline in exports during the analysis period is explained by the drop in international demand for Peruvian goods.

Our findings on the different margins of trade provide new insights on the role of finance in the dynamics of exporting activity. Consider for example the benchmark model of trade with sunk entry costs.[3] In such a framework, a negative credit shock will affect the entry margin, but once the initial investment is covered, credit fluctuations should not affect the intensive margin of trade or the probability of exiting an export market. Our results on the elasticity of the intensive margin of trade suggest that credit shocks affect the *variable* cost of exporting. By increasing the marginal cost of exporting, adverse credit conditions reduce the equilibrium size and profitability of exports. In combination with fixed costs, the profitability decline will induce firms to discontinue small export flows, which are closer to the break-even point, consistent with our findings.

The observed link between finance and the variable cost of exporting can arise from the requirements of working capital by the firm, which becomes costlier after a negative credit shock. Although this requirement is general to all production, the elasticity of international trade to credit shocks is potentially larger than the elasticity for domestic sales: cross-border sales require insurance, letters of credit, and more working capital, as there is a longer period

[3]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.

between production and collection than for domestic sales.[4] Under the hypothesis that exporting to more distant market requires additional working capital due to longer freight time, we test whether the elasticity to credit changes with distance to destination. We do not find compelling evidence in favor of this interpretation: the estimated elasticity does not vary with distance.

Our results pertain to the elasticity of trade to short-run credit fluctuations. Long-term finance availability has also been found to have an impact on the patterns of trade in other studies: countries with developed financial markets have comparative advantage in sectors characterized by large initial investments (see Beck (2003) and Manova (2008)).[5] We explore whether factors found to affect the sensitivity to long-term finance can also predict the effect of short-term credit shocks. We look, in particular, at the heterogeneity of the estimated elasticity across sectors with different external finance dependence, measured as in Rajan and Zingales (1998). This measure represents firms' technological requirements of capital and it is found to predict the sensitivity of sectoral exports to long-term financial conditions. On the other hand, the elasticity of exports to credit shocks estimated here is found to be constant across sectors with different measure of external finance dependence. This result suggests that the elasticity to short-term and long-term changes in financial conditions represent different aspects of the firm's usage of credit; they are complementary measures for understanding the link between trade and finance.

We contribute to a growing body of research that studies the effect of financial shocks on trade (see, for example, Bricongne, Fontagne, Gaulier, Taglioni and Vicard (2009), Iacovone and Zavacka (2009), Chor and Manova (2010), Levchenko et al. (2010), and Amiti and Weinstein (2009)).[6] While this literature has been able to show that credit shocks affect exports, it recovers reduced form estimates that cannot be linked to meaningful structural parameters. As a result,

[4]See Hummels (2001), Auboin (2009), and *Doing Business* by the World Bank for evidence on these factors. See also Amiti and Weinstein (2009) for supporting evidence on the elasticity differential between export and domestic activities and Ahn (2010) for a model that rationalizes this phenomenon.

[5]Manova, Wei and Zhang (2009) also use this cross-sectional methodology to analyze the export performance of groups of firms with heterogenous degrees of credit constraints: multinational, state-owned, and private domestic firms.

[6]The bulk of the literature on financial shocks and trade, Amiti and Weinstein (2009) being an exception, uses sectoral heterogeneity in external financing dependance as an indicator of export sensitivity to credit to show that country specific financial conditions are correlated with the relative export performance of finance sensitive sectors.

so far it has been difficult to assess the importance of credit in explaining export variation across firms and in the time series. Our empirical approach and data allow us to present the first estimates for the elasticity of exports to credit that can be used to parametrize quantitative analysis.

Finally, the results emphasize the role played by commercial banks in the international transmission of financial shocks to emerging economies. This channel is believed to be an importance source of contagion during the subprime crisis (see Cetorelli and Goldberg (2010) and IMF (2009)). Existing work provides evidence that banks' share of foreign liabilities are a good predictor of lending performance in times of international capital reversal (Schnabl (2010)). Our results extend these findings by showing that this transmission channel affects real economic activity.[7]

The rest of the paper proceeds as follows. Section 2 describes the data. Section 3 describes in detail the empirical strategy. In Section 4 we show the estimates of the export elasticity to credit supply. Section 5 we analyze how the sensitivity of exports to credit shocks varies according to observable characteristics of the export flow. In section 6 we discuss the lessons obtained by this empirical exercise and perform a back of the envelope calculation of the contribution of the credit channel to the drop in Peruvian exports during the subprime crisis. Section 7 concludes.

2 Data Description

We use three data sets for the empirical analysis: bank level data on Peruvian banks, firm level data on credit in the domestic banking sector, and customs data for Peruvian firms. We obtain the first two data sets from the Peruvian bank regulator Superintendence of Banking, Insurance,

[7] In general, there has been limited success in determining the consequences of credit supply shocks on real outcomes. Following early work by Bernanke and Blinder (1992) and Kashyap, Lamont and Stein (1994), recent papers have provided evidence that credit supply responds to shocks to bank balance sheets but have not assessed the effect on economic activity (see, for example, Kashyap and Stein (2000), Ashcraft (2005), Ashcraft (2006), Gan (2007), Khwaja and Mian (2008), Paravisini (2008), Chava and Purnanandam (2011), and Iyer and Peydro (2010)). Exceptions are Peek and Eric Rosengren (2000), which looks at changes in real estate economic activity in U.S. states with large presence of Japanese banks after the Japan bank crisis, and Kalemli-Ozcan, Kamil and Villegas-Sanchez (2010), which compares investment by foreign- and domestically-owned firms after financial crises in Latin America.

and Pension Funds (SBS). We obtain 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. We match the loan data to export data using the unique tax identifier provided in both data sets. All data are public information.

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 bank descriptive statistics of the 13 commercial banks operating in Peru during this period.[8] The credit data is 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. Exports are concentrated around 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 during the decade leading to the crisis, and suffered a sharp drop in 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 second half of 2008. The timing of this decline aligns closely with the sharp collapse of world trade during the last quarter of 2008.

Table 2 provides the descriptive statistics of Peruvian exporting firms. The universe of exporters includes all firms with at least one export registered between July 2007 and June 2009. The descriptive statistics correspond to the period July 2007-June 2008, prior to the beginning of the financial crisis. The average debt outstanding of the universe of exporters as of December 2007 is $734,000 and the average level of exports is $3.1 million. The average firm exports to 2.75 destinations with an average distance of 6,040 kilometers. The average number of

[8]We exclude the Savings and Loans from the statistics since these do not participate actively in lending to exporters.

four-digit products is 5.3 and the average number of product-destinations is 8.7. 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 sample are larger than in the full sample. For example, average debt outstanding in the analysis sample is $909,000 and average exports is $3.8 million.

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., willingness to pay for product p in country d, the income level of 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 identification problem is that the amount of credit, C_{it}, is a function of real demand and supply factors, H_{ipdt}, as well as determinants of the supply of finance faced by the firm, S_{it}:

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

To address this problem, we perform an instrumental variable estimation of a model that accounts for all unobserved heterogeneity in the cross section of firm-product-destination export flows, and controls for shocks at the product-destination level. As an instrument for the supply of credit, we use shocks to the balance sheet of the lenders to firm i. We explain in detail each

of these aspects of the empirical strategy below.

3.1 Empirical Model

We separate the real determinants of exports, H_{ipdt}, in three components: 1) time-invariant firm-product-destination heterogeneity, δ_{ipd}, 2) shocks to the productivity and demand of exports at the product-country level, α_{pdt}, and 3) firm idiosyncratic shocks, ε_{ipdt}. 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. The last component captures firm idiosyncratic shocks, such as plant stoppages due to machine breakdowns or fire. The trade data at the firm-product-destination level used in this study allow us to fully account for the first two real determinants of exports. The third component is captured in the error term. Specifically, we estimate 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, δ_{ipd}, and the product-destination shocks, α_{pdt}. Our parameter of interest is η, the elasticity of exports to credit.

Despite the flexible empirical specification, OLS estimation of η in equation (3) will be biased because the endogenous relationship between credit and real factors established in equation (2) implies a correlation between C_{it} and the error term, ε_{ipdt}. We estimate equation (3) 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 explain the economic rationale behind the instrument, and discuss the identification hypotheses behind the instrumental variable (IV) estimation next.

3.2 Bank Foreign Liabilities and the Supply of Credit during the Subprime Crisis

Bank lending growth in Peru declined sharply after the collapse of Lehman Brothers in September of 2008. Although this trend characterizes all Peruvian financial institutions, there were differences across banks depending on their share of foreign liabilities (see Figure 2).

Portfolio capital inflows, that were growing prior to the crisis, stopped suddenly in mid 2008; the same evolution characterizes total foreign lending to Peruvian banks (see Figure 3). This liquidity shock led to a decline in lending, specially for banks that relied the most on borrowing in foreign markets. As Figure 2 illustrates —and we formally demonstrate below–, the market share of domestic lending by banks with above the median foreign liabilities to assets dropped by 6 percentage points during 2008.[9] Based on the evolution of total foreign lending to Peruvian banks, we set July 2008 as the turning point for the relative lending performance of banks with heterogeneous share of foreign liabilities.

We use banks' heterogenous dependence on foreign capital *before* the crisis, interacted with the aggregate decline in foreign funding *during* the crisis, as a source of variation in bank supply of credit. To construct the instrument we first rank banks according to their dependence on foreign liabilities in 2006, a year before the crisis. A bank b is considered to be *exposed* if the share of foreign liabilities in its balance sheet is above the mean (9.5%); in that case, the indicator variable FD_b is equal to one and zero otherwise.

Of the thirteen commercial bank in the sample, four are classified as exposed.[10] Both groups of commercial banks include local and foreign owned institutions. For example, the pre-crisis foreign liabilities of HSBC and Banco Santander, two large foreign owned banks, are 17.7% and 2.2% of assets, respectively. Thus, HSBC is classified as exposed and Santander as not exposed. The fraction of loans to exporting firms by exposed and non-exposed commercial banks is 53.9%

[9] See Banco Central de Reserva del Peru (2009) for an analysis of the performance of the domestic financial market during the subprime crisis.

[10] The exposed banks are Citibank, Continental, HSBC, and MiBanco. Not exposed banks are Credito, Comercio, Financiero, Interamericano, Interbank, Santander, Trabajo, and Wiese.

and 60.5% respectively. All Savings and Loans Institutions are classified as not exposed and lend almost exclusively to individuals and non exporting small firms.

Table 1 provides the descriptive statistics of the two groups of commercial banks: Banks with above-mean exposure to foreign borrowing and banks with below-mean exposure to foreign borrowing as of December 2007. High foreign exposure banks are slightly smaller than low foreign exposure banks with total assets of $2.5 bn relative to $2.8 bn. Both high and low foreign exposure banks have loans worth more than 60% of assets and finance more than 50% of assets with retail deposits. The main difference between the two types of banks is that foreign finance represents 19.6% of total liabilities for high exposure banks relative to 5% for low exposure banks.

We use an instrumental variable strategy to predict variations in the supply of credit to firm i in time t. In the baseline estimations the functional form of the instrumental variable is

$$F_{it} = F_i \cdot Post_t, \tag{4}$$

where the indicator function F_i is one if firm i borrows more than 50% from exposed banks in 2006, and zero otherwise; $Post_t$ is an indicator variable that turns to one after July 2008, when the decline in foreign liquidity begins. The cross sectional variation in F_{it} comes from the amount of credit that firm i receives from exposed banks in 2006. 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 time series variation in F_{it} is given by the aggregate decline of foreign liquidity in the Peruvian economy. In robustness checks, we also define F_i as the fraction of the firm's total debt that came from exposed banks in 2006.

3.2.1 Identification Hypothesis 1: Foreign Dependence and Credit Supply

Our first identification hypothesis is that banks with larger fraction of their funding from foreign sources reduce the supply of credit relative to other banks after the crisis. This hypothesis is consistent with the decline in the market share of total lending by exposed banks observed

in Figure 2. We can test this identification assumption formally by following the *within-firm* estimation procedure in Khwaja and Mian (2008) to disentangle credit supply from changes in the demand for credit.

The *within-firm* estimator entails comparing amount of lending by banks with different dependence on foreign capital, to the *same firm*. The empirical model is the following:

$$\ln(C_{ibt}) = \theta_{ib} + \gamma_{it} + \beta \cdot FD_b \cdot Post_t + \nu_{ibt} \tag{5}$$

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, respectively. As defined above, FD_b is a dummy that takes value one if the share of foreign liabilities of bank b is above the mean (9.5%) and zero otherwise, and $Post_t$ is a dummy that signals whether $t = Post$. 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 the change in credit supply by banks with higher dependence of foreign capital.

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 liquidity supply shock to the firms. Banks with share of foreign liabilities above the median contracted lending almost 17% relative to banks with lower exposure, once the demand for credit is accounted for.

It is important to emphasize that the identification assumption tested above, that the instrument be correlated with the *supply* of credit, is much stronger than the typical necessary condition for the IV estimation of equation (3), i.e., that the instrument be correlated with the *amount* of credit. We present the first stage regression of the instrument on credit in Section 4,

and show that this weaker necessary condition also holds.

3.2.2 Identification Hypothesis 2: Exclusion Restriction

Our second identification assumption is that the instrument is conditionally uncorrelated to the error term in equation (3). Formally, the exclusion restriction is:

$$E\left[(F_i \cdot Post_t) \cdot \varepsilon_{ipdt} | \delta_{ipd}, \alpha_{pdt}\right] = 0. \tag{6}$$

Conditioning on firm-product-destination heterogeneity, and on product-destination shocks is not necessary if firms are randomly matched to banks. In this case, firm characteristics and shocks are uncorrelated to bank exposure. However, the instrument is likely to be correlated to other firm level determinants of exports. Table 2 provides the descriptive statistics of firms classified in two groups according to our main definition of F_{it}: firms that borrow more than 50% from exposed banks in 2006, and those that do not. Firms that borrow from affected banks have a larger fraction of their bank debt denominated in foreign currency, tend to be larger according to their overall debt and exports, their exports are concentrated on products with higher unit value, and they serve more destinations. These patterns suggest that the matching between firms and banks is not random.

Such non-random matching may lead the instrument to be unconditionally correlated to firm exports. For example, suppose that banks with higher foreign liabilities specialize in firms that export *Men's Cotton Overcoats* to the U.S.. If the demand for Men's Overcoats in the U.S. drops disproportionately during the crisis, then the unconditional correlation of the external exposure instrument and changes in the demand for credit is positive.

Our identification strategy does not require the unconditional correlation to be zero. Our identification assumption is much weaker: that non-finance determinants of exports and the instrument are uncorrelated after conditioning on time-invariant flow characteristics, δ_{ipd}, and product-destination shocks, α_{pdt}. 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 an exposed

bank, relative to the change in Men's Cotton Overcoat exports to the U.S. of a firm whose lender is not exposed. Thus, the identification assumption is that factors other than bank credit that may affect the exports of mens' cotton overcoats differentially across these two firms during the crisis are not related to the bank the firms borrow from.

A violation of this conditional exclusion restriction would require, for example, that production stoppages due to equipment breakdowns become more frequent during the crisis for firms that borrow from banks with a high fraction of foreign liabilities.[11] Such a correlation between bank affiliation, and idiosyncratic shocks to exports of the same product and to the same destination are unlikely. To corroborate this, we demonstrate in the results section that our point estimates are unchanged when we allow same product-destination exports to vary differentially 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.

4 Effect of Credit Supply Shock on Trade

In this section we use the methodology described above to estimate the elasticity of exports to credit. We estimate separately the elasticity in 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 number of firms that enter or exit a product-destination market. In the baseline specifications products are defined at the 4-digit level according to the Harmonized System (HS). As a result, all 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

[11] Note that a negative credit supply shock may cause production stoppages, for example, due to financial distress. This does not invalidate our identifying assumptions.

along these margins. Export growth declined over 32 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%. One third of this decline is explained by the drop in the intensive margin. The rest is explained by the increase in the number of firms abandoning product-destination export markets. The elasticity estimates from this section allow us to calculate the fraction of this variation that can be attributed to the decline in credit supply.

4.1 Intensive Margin of Trade

We estimate equation (3) by first differencing to eliminate the firm-product-destination fixed effects. To address concerns related to estimation bias due to serial correlation, we collapse the panel into two periods, Pre and $Post$, that correspond to the 12 months before and after July 2008, respectively (see Bertrand, Duflo and Mullainathan (2004)). Thus, X_{ipdt} corresponds to aggregate exports of product p to destination d by firm i in the period $t = \{Pre, Post\}$. The resulting estimation equation is:

$$\ln\left(X_{ipdPost}\right) - \ln\left(X_{ipdPre}\right) = \alpha'_{pd} + \eta \cdot \left[\ln\left(C_{iPost}\right) - \ln\left(C_{iPre}\right)\right] + \varepsilon'_{ipd} \tag{7}$$

The product-destination dummies, $\alpha'_{pd} = \alpha_{pdPost} - \alpha_{pdPre}$ in equation (3), absorb all demand fluctuations of product p in destination d.

The first stage coefficient —i.e., a linear regression of credit of firms i at time t (C_{it}) on the instrument (F_it)– is shown in Column 1, Panel 1 of Table 5. The coefficient is negative and significant at the 1% level, which confirms that the instrument is correlated with the amount of credit.

The results of both the OLS and the Instrumental Variable (IV) estimations of the export elasticity to credit supply in specification (7) are presented in Table 5. The IV estimate implies that a 1% increase in the stock of credit results in an increase of 0.23% in the volume of yearly export flows and 0.26% in their value (Panel 1). The volume and value elasticities are similar, which confirms that our estimation strategy properly accounts for shocks to export prices. We

obtain elasticity estimates of the same magnitude if we define export markets at the 6-digit level, according to the Harmonized System (see Panel 2 in Table 5). This indicates that the observed results are not driven by measurement error or unaccounted for variation in export shocks at narrower product markets.

The IV estimate of the export elasticity to finance is ten times that implied by the OLS estimate. This highlights the importance of firms' credit demand in explaining the drop in total lending during this period. The OLS estimate is biased downwards because the credit supply shock explains only a small portion of the overall drop in firms' credit during the crisis. Moreover, during the period under analysis, it is crucial to control for export demand. It is shown in the Appendix that not controlling for common fluctuations in exports at the product-destination level would lead to overestimate the impact of credit supply on the intensive margin of exports by over 65%.

We compute the effect of credit on the size and frequency of the firm's export shipments. We estimate equation (7) using, as dependent variable, the (log) number of shipments per year of a given product-destination ($ShipFreq_{ipd}$) and their average size measured, both, in volume and FOB value ($ShipVol_{ipd}$ and $ShipFOB_{ipd}$). The estimated elasticities are shown in Table 6. The elasticity of shipment frequency is 0.14 and statistically significant at the 1% level. The elasticity of shipment size is 0.09 when measured in volumes, and 0.12 when measured in values, but only the first estimate is statistically significant at the conventional levels.

4.2 Extensive Margin of Trade

We analyze the effect of a credit supply shock on the *number of firms* that enter and continue exporting in product-destination markets. To count the number of entering and continuing firms we aggregate the data at the product-destination-group level, where group refers to a classification of firms into two groups ($F = \{1, 0\}$) according to their exposure to credit shocks: those with at least 50% of their debt with affected banks (firms i such that $F_i = 1$) and those with most of their debt with non affected banks (firms i such that $F_i = 0$). Then we estimate

the following equation:

$$\ln N_{Fpdt} = \delta_{Fpd} + \alpha_{pdt} + \nu \cdot \ln\left(\sum_{i \in F} C_{it}\right) + \xi_{Fpdt} \tag{8}$$

To study the entry margin, we use as the left-hand side variable the number of firms in group F that start exporting product p to destination d at time t, for $t = \{Pre, Post\}$ (N^E_{Fpdt}). To study the continuation margin, we use the number of firms in group F that were exporting product p to destination d at time $t-1$ and continue doing so in time t, for $t = \{Pre, Post\}$ (N^C_{Fpdt}).

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 right-hand side variable of interest, debt, is now also defined at the product-destination-group level: it is the (log) sum of debt outstanding for all firms in group F at time t, $\ln(\sum_{i \in F} C_{it})$. As before, we instrument debt with a function F_{it}, defined in equation (4), that predicts the credit supply to the firms in group F, based on the external dependence of its related banks.

We include product-destination-time dummies, α_{pdt}, that control for changes in demand and productivity. This specification differs from the one in (7) in that the unit of observation is defined at the group-product-destination level. The fixed effects δ_{Fpd} control for any time-invariant heterogeneity of exports of product p to destination d by the group of firms F, instead of controlling at the firm-product-destination level as in specification (7).

We estimate the parameter ν after first differencing equation (8) to eliminate the group-product-destination fixed effect. The dependent variables are therefore $\Delta \ln N^E_{Fpdt}$ and $\Delta \ln N^C_{Fpdt}$, respectively.

The entry margin results are presented in Table 7, Columns 1 and 2, for product definition at the 4 and 6 digit level, according to the Harmonized System. The elasticity of the entry margin to credit is not statistically significant. Columns 3 and 4 show the results concerning

the continuation margin. According to our preferred specification, using product definition aggregated at 4-digit level, a 1% increase in the stock of credit increases the number of firms continuing exporting a given product-destination flow in 0.36%. The estimate of the continuation elasticity drops to 0.275 when export markets are defined at the 6-digil HS level. This potentially reflects that the misclassification of exports into very narrow categories is more likely with highly disaggregated product data. Such misclassification has a first order effect on measurement error of the extensive margin of trade (see Armenter and Koren (2010) for a discussion). Therefore, the continuation elasticity using 6-digit product categorizations is potentially biased downwards due to classical attenuation bias.

4.3 Identification Tests

In this section we perform three identification tests. The first one tests for potential unaccounted correlations between firm export sensitivity to the crisis and bank affiliation. The second, tests for pre-existing differential trends in the export and borrowing behavior of firms linked with exposed and non-exposed banks. The third one tests the robustness of the estimated elasticities to the instrument definition.

As we mentioned in Section 3, the exclusion restriction in (6) will be violated 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. This could occur, for example, if firms that borrow from affected banks export products of a higher quality, and the demand for higher quality products dropped more during the crisis. Alternatively, it could be that 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.

To verify whether the above results are driven by such heterogeneity, we augment equation (7) with a set of observable firm 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 (3). Thus, this augmented specification controls for heterogeneity in the evolution of exports after the crisis along the product quality, firm external exposure, and firm size dimensions. The elasticities of, both, the intensive and extensive margins of exports (in Panel 1, Table 8) are virtually identical to those computed without controls.

In the second test 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. We perform the following placebo test: we estimate equation (7) 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 2 of Table 8, are not statistically different from zero.[12] This confirms that firms borrowing from banks with 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 lower share of foreign liabilities. Overall, the results in Panel 1 and Panel 2 of Table 8 suggest that our instrument satisfies the exclusion restriction and it correctly identifies the effect of credit supply shocks to the firms during the subprime crisis.

Finally, we test the robustness of our estimates to the functional form of the instrument. If the identification assumptions hold, the instrumental variable approach should obtain consistent estimates regardless of the definition of the instrument. To verify this, we substitute the indicator variable F_i with a continuous function, defined as the maximum fraction of total funding that firm i obtained from exposed banks during 2006. The results, qualitatively and quantitatively

[12]The OLS estimates in this placebo test (not reported) are positive, indicating that exports and debt are positively correlated. This positive correlation is natural and expected: firms that export more also borrow more for reasons unrelated to credit supply shocks. This emphasizes the importance of or instrumental variable approach.

similar to those described above, are presented in Panel 3 of Table 8.

5 Characterization of Export Elasticity to Credit

In this section we analyze how the export sensitivity to credit shocks varies according to observable characteristics of the firms, the export flow, and the product.

5.1 Firm Heterogeneity

Larger firms potentially have sources of finance other than banking and are therefore less sensitive to bank credit supply shocks. Moreover, larger firms tend to borrow from multiple banks, which may facilitate the substitution if one of the lending institutions reduces credit supply. If that is the case, the effect of bank shocks on overall exports may be small, as export distribution across firms is very skewed. We obtain mixed results regarding these hypotheses.

Table 9 shows how the elasticity of exports to credit varies in the cross section with firm size, measured with the volume of overall exports, and number of creditors (panels 1 and 2 respectively). The intensive margin elasticity does not vary significantly in the cross section with either firm size of number of lenders (columns 1 and 2). Neither does the entry margin elasticity (column 3). Only the continuation margin elasticity shows some cross sectional heterogeneity: the number of firms that continue exporting to a product-destination is more responsive to credit conditions for large exporters (Column 4).

These cross sectional patterns are potentially specific to the overall availability of external financing during the financial crisis. Alternative sources of financing, usually available to larger firms, disappeared during our sample period. For example, between March and October of 2008 the spread on domestic corporate bonds increased more than 400bp and firms avoided issuing new debt until mid 2009 (see Banco Central de Reserva del Peru (2009)). Given these macroeconomic conditions, our estimated coefficients can be interpreted as elasticities of exports to changes in overall finance, and not only to bank credit.

Interestingly, although the intensive margin elasticities are statistically equal for small and

large exporters, the overall effect of credit supply shocks on the amount of exports is not. During the crisis, illiquid banks cut credit disproportionately more to small firms. We estimate equation (5) for firms of different sizes and find that affected banks reduced credit supply by 19.5% in the case of small firms and 13.5% in the case of large ones (see Table 3). Combining the magnitude of the credit supply shock and the elasticity of exports to finance in Table 5, a *back of the envelope* calculation of the drop in the intensive margin of (volume of) exports due to reduction in credit is 4.5% and 3.1% for small and large exporters respectively (relative to firms borrowing from non exposed banks).

5.2 Export Flow Heterogeneity

Table 10 reports the difference in the export elasticity to credit across observable characteristics of the export flows, namely, the size of the flow and the distance to destination. These variations add to the characterization of the cost of exporting.

If exports are characterized by fixed costs, firms may abandon a given market when sales drop below the minimum level required for the activity to be profitable. As it was already established in the previous section, credit shocks affect the intensive margin of exports. In this scenario, credit conditions are expected to disproportionately affect the continuation margin for small export flows, which are more likely to drop below the break even point. The results in Panel 1, Table 10 are consistent with this hypothesis. For those export flows that remain active during the whole period (intensive margin in columns 1 and 2) the elasticity to credit shocks is similar across flows of different size. The continuation margin, on the other hand, is more sensitive to credit shocks for small export flows than for larger ones: 0.54 and 0.15 respectively (column 3, Panel 1). The difference is significant at the 10% level.

The export elasticities to credit shocks computed in the previous section account for, both, the effect of the credit shock on the general variable cost of producing, irrespectively of the destination of the goods, and the additional impact of finance on cross-border trade. Presumably, as the freight time for international trade is longer than for domestic transactions, exports

are more responsive to credit than domestic sales. To explore this link, we analyze how this elasticity changes with distance to the destination market. The hypothesis that the working capital required to finance exports increases with distance due to longer freight time. The results in Panel 2 of Table 10 do not support this interpretation. The elasticity is statistically indistinguishable for exports to close and distant markets.

5.3 Sectorial Heterogeneity

In the United States, characterized by relatively frictionless financial markets, firms of different manufacture sectors vary in their *external finance dependence*. Since the seminal work by Rajan and Zingales (1998), this source of heterogeneity 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. It remains to be shown whether those factors considered to affect the sensitivity 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, from cross sectoral data of U.S. firms. This measure is considered to represent technological characteristics of the sector of firm. 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 11, Panel 1, the result of estimating equations (7) and (8) augmented with an interaction between all the right-hand side variables with a dummy equal to one if the the product belongs to an industry with above median external financial dependence. The point estimate on the interaction term with debt is close to zero in all specifications, indicating that the elasticity of the intensive margin of exports to credit shocks does not vary across sectors

with different levels of external finance dependence.

Our results suggest that the elasticities to short-term and long-term changes in financial conditions represent different aspects of the firm's usage of credit. The measure of external finance dependence may indicate the sensitivity of the firm to long term access to credit, which is potentially related to the presence of important fixed investments or entry costs. The elasticity of exports to credit shocks, on the other hand, is related to the short term needs of working capital.

Cross sectoral analysis on the impact of credit shocks on exports uses, as indicator of the sector sensitivity to short term credit, the average usage of trade credit —i.e. the sector average ratio of the change in accounts payable over the change in total assets– (Chor and Manova (2010)). Panel 2 of Table 11 shows how the elasticity estimated in the previous section varies for sectors with high share of trade credit. The point estimates are positive, but not statistically significant.

The elasticity to credit shocks does not vary across other sectoral characteristics. It is constant for intermediate or final goods, and does not change with the elasticity of substitution in the demand function of the good (Panels 3 and 4 in Table11).[13]

6 Lessons from the Empirical Exercise

The findings above provide valuable information on the usage of credit by the firm and the nature of the costs of exporting. Moreover, obtaining the value of structural parameters, such as the elasticity of exports to credit, allow us to quantify the impact of credit fluctuations on overall exports. These are the topics discussed in this section.

[13]The classification of vertical linkages is from Levchenko et al. (2010), the sectoral index of usage of trade credit and external dependence follows Chor and Manova (2010), and the elasticity of substitution is from Broda and Weinstein (2006).

6.1 Characterization of the Link between Credit and Exports

The results in this paper contribute to the characterization of the link between financial markets and exporters.

The first set of conclusions pertain the relationship between finance and export dynamics. A positive and economically significant *intensive margin* elasticity of export to credit, implies an important link between credit and the variable cost of exports. Existing theoretical models of finance and trade, motivated by frictions in funding sunk costs of entry in new export markets, cannot account for this empirical pattern. In such frameworks, a negative credit shock will affect the entry margin, but once the initial investment is covered, credit fluctuations should not affect the volume of exports. Our findings call for a framework in which credit frictions affect the *variable* cost of exporting —i.e., the cost of working capital. Then, adverse credit conditions reduce the equilibrium size of exports by increasing the marginal cost of producing and exporting. This usage of credit is fundamentally different from the one proxied by the measure of *external finance dependence* developed by Rajan and Zingales (1998), which aims to capture long term credit dependence. This explains why the estimated elasticities do not vary across sectors with different external finance dependence.

Also, the findings in this paper also suggest the existence of fixed costs of exporting to a product-destination market. Then, a negative credit shock, by reducing the size and profitability of exports, induce firms to abandon an export market. This explains why credit is found to affect the continuation margin, especially for small product-destination export flows, which size is closer to the break even point.

Our results cannot establish whether the elasticity of exports to credit is different from that of domestic sales. This link can emerge from the general requirements of working capital by the firm, which becomes costlier after a negative shock. However, as the time elapsed in cross-country activities is typically larger and these transactions often require banking service, there are reasons to believe that the sensitivity to credit is larger for exports than for domestic sales. We indirectly explore this possibility by analyzing how the elasticity changes with distance to

the destination market, under the assumption that more distant destinations require additional working capital due to longer freight time. We do not find compelling evidence in favor of this interpretation: the estimated elasticity does not vary with distance. Moreover, the frequency and size of the export shipments equally respond to the credit shock. We cannot therefore infer the existence of important shipment fixed costs.

The second set of conclusions are related to the specificity embedded in the relationships between exporters and their lenders. Our findings imply that firms and banks are not randomly matched. Instead, banks specialize in lending to firms that export to certain product-destination markets. In particular, the specialization seems to be on country of destination; in our case, exposed banks specialize in markets that are disproportionately affected by the financial crisis.[14] This explains why not controlling for fluctuations at the product-destination level biases upwards the elasticity of the intensive margin. Along the same lines, since firms that borrow from exposed banks face a disproportionate negative real shock, they also reduce their credit demand beyond firms borrowing from not affected banks. This explains why the relative drop in the *amount* credit by firms linked to exposed banks was 56% (Column 1, Panel 1 Table 5), much larger than the relative reduction in the *supply* of credit by exposed banks, 17% (Table 3).

6.2 Contribution of Finance to Overall Export Decline

In this subsection, we use the estimated elasticities to perform a *back of the envelop calculation* of the contribution of finance to the overall export decline during the period under analysis.

The magnitude of the supply shock was estimated with equation (5), which controls for changes in the demand of credit at the firm level. Affected banks contracted credit supply 16.8% beyond the change in supply by non affected banks (see Table 3). These banks accounted for 30.5% of total credit to exporters in the *Pre* period (12 months before July 2008). We take the conservative stand that non affected banks —i.e., banks with share of foreign liabilities below 9.5%– were not liquidity constrained. Then, the overall drop in credit supply was 5.1%.

[14]The upward bias is largest when there are no controls for fluctuations at destination (see Appendix).

The effect of the credit shock on the intensive margin of exports is found to be statistically equal for small and large export flows (Table 10). Then, we consider the intensive margin elasticity for the volume of exports in Table 5, 0.23. In the case of the continuation margin, on the other hand, the elasticities change significantly with the size of the flow (10). Since export flows of size below median account for less than 2% of total exports, our back of the envelope calculation focuses only on the estimates characterizing the performance of large flows, 0.15. The exit margin is not found to be significantly affected by the credit supply shock. Then, the drop in credit supply explains a reduction in the volume of exports during the 12 months following July 2008 (*Post* period) of –1.9%.

Most of the reduction in the value of exports was due to the collapse in international prices of Peruvian goods. The total drop in the annual growth rate of the value of exports between the *Pre* and *Post* periods was 33.3 percentage points, while in volume this difference is reduced to 12.8 percentage points (see Table 4). Then, the drop in credit supply can account for approximately 15% of this missing volume of trade.

Following the decomposition in export growth rates presented in Table 4, we decompose the total missing volume trade in intensive and extensive margins. The intensive margin, that was growing at 2.1% in the 12 months of the *Pre* period, declined 2.2% during the *Post* period. Finance alone can account for 27% of this drop. However, the intensive margin accounts for only 33% of the missing trade, while 64% of the missing trade is explained by the increase in the exit margin, which doubled between the *Pre* and *Post* periods. The credit shock can explain 9% of the exit margin. This suggests that the large increase in the exit margin during the 12 months following July 2008 was triggered by the contraction in international demand and prices for Peruvian goods, which made the value of the trade flows insufficient to cover the export fixed costs.

7 Conclusions

It has long been argued that shocks to banks liquidity are transmitted to the credit conditions of related firms. There is no evidence, however, of their consequences in terms of real outcomes. In this paper, we provide evidence of this link. Banks subject to liquidity shocks change their lending to firms, which in turn adjust their volume of exports.

Our results stem from analyzing Peruvian exports during the subprime crisis. Although Peru was not directly affected by the collapse in the value of U.S. real estate, the capital flow reversal during the international financial crisis affected the lending capacity of domestic commercial banks. We use this drop in the supply of credit to Peruvian firms to estimate the sensitivity of exports to credit. We find that the elasticity of the intensive margin of exports is 0.23. Firms adjust the intensive margin of exports after a credit shock by re-optimizing, both, the frequency and size of the export shipments to a given destination. And, finally credit is found to affect the number of firms that continue exporting, and the elasticity is larger for small export flows. Short term fluctuations in credit supply, on the other hand, are not found to significantly affect the decision of firms to entry a new export market.

These results cast light on the link between finance and production activities. They suggest that credit shocks affect the variable cost of the firm —in particular, of exporting. When credit conditions tighten, the unit cost of exports increases and, as a result, sales drop. Moreover, our results suggest the existence of fixed costs of exporting (at the product-destination level). Then, an increase in the variable cost of exporting following the tightening of credit conditions triggers firms to discontinue small export flows, which are close to the break-even point.

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Appendix

A Estimation Bias

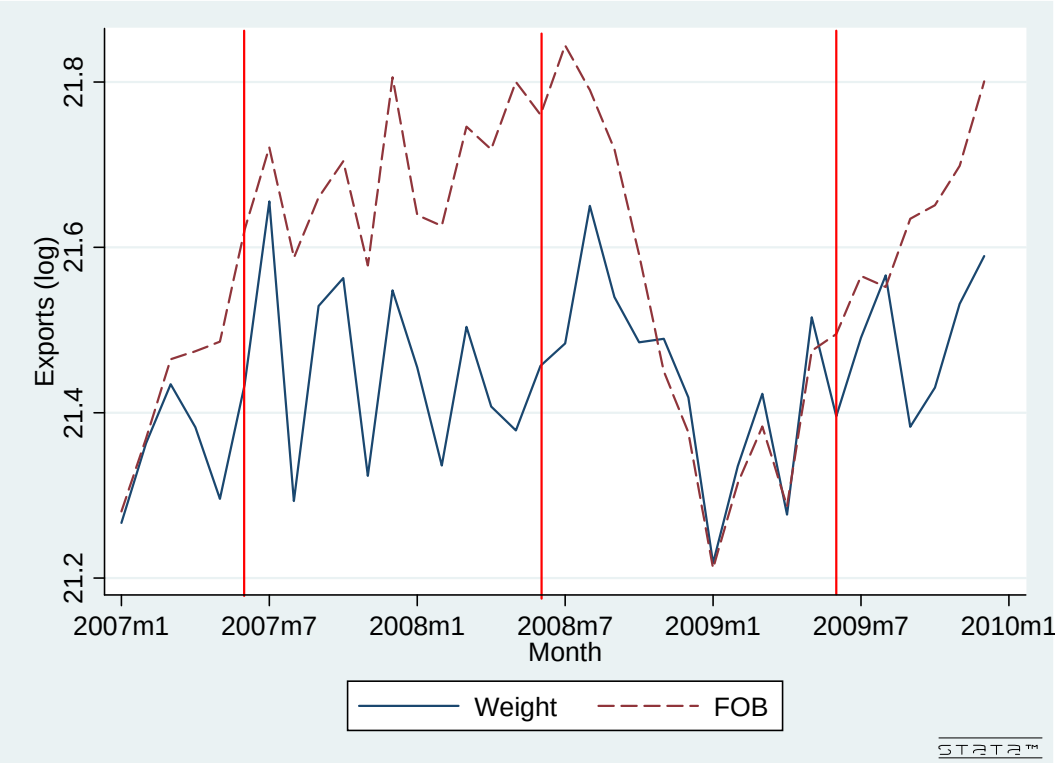
This appendix computes the bias in the estimated intensive margin elasticity that would arise if we do not account for all shocks to exports at the product-destination level. This is an important question since most empirical estimates of the effect of finance on credit use data that are not disaggregated at the firm-product-destination level, and thus cannot account for such variations.

We present in Table A.1 the elasticity estimate if no information on products or destination were available. In our environment, this leads to overestimate the impact of the credit supply shock by over 65% in the volume and 54% in the value of exports. Columns 2 and 5 in Table A.1 correspond to the estimation based on firm exports by product, aggregated across all destinations. In this case, the specification imperfectly controls for fluctuations in demand by including product-time dummies, but cannot account for variations in demand driven by destination shocks. The resulting coefficients overestimate the elasticity of the value of exports to credit supply by 16% (9% in value). Finally, columns 3 and 6 are based on overall firm exports by destination, aggregated across all products. The specification includes destination-time dummies, but cannot account for its interaction with product demand. The resulting coefficients, although statistically insignificant, are the ones closest to our estimates in Table 5. These estimates imply that during the period under analysis, controlling for the country of destination is crucial to correctly estimate the elasticity of exports to finance.

Dependent Variable:	$\Delta \ln Vol_i$ (1)	$\Delta \ln Vol_{ip}$ (2)	$\Delta \ln Vol_{id}$ (3)	$\Delta \ln FOB_i$ (4)	$\Delta \ln FOB_{ip}$ (5)	$\Delta \ln FOB_{id}$ (6)
$\Delta \ln C_i$	0.376***	0.263***	0.234	0.396***	0.280***	0.255
	(0.116)	(0.077)	(0.187)	(0.110)	(0.080)	(0.212)
FE	no	prod	dest	no	prod	dest
Observations	2,438	5,811	5,421	2,438	5,812	5,421
# firms	2,438	1914	1834	2,438	1914	1834
# destination			140			140
# products		759			758	

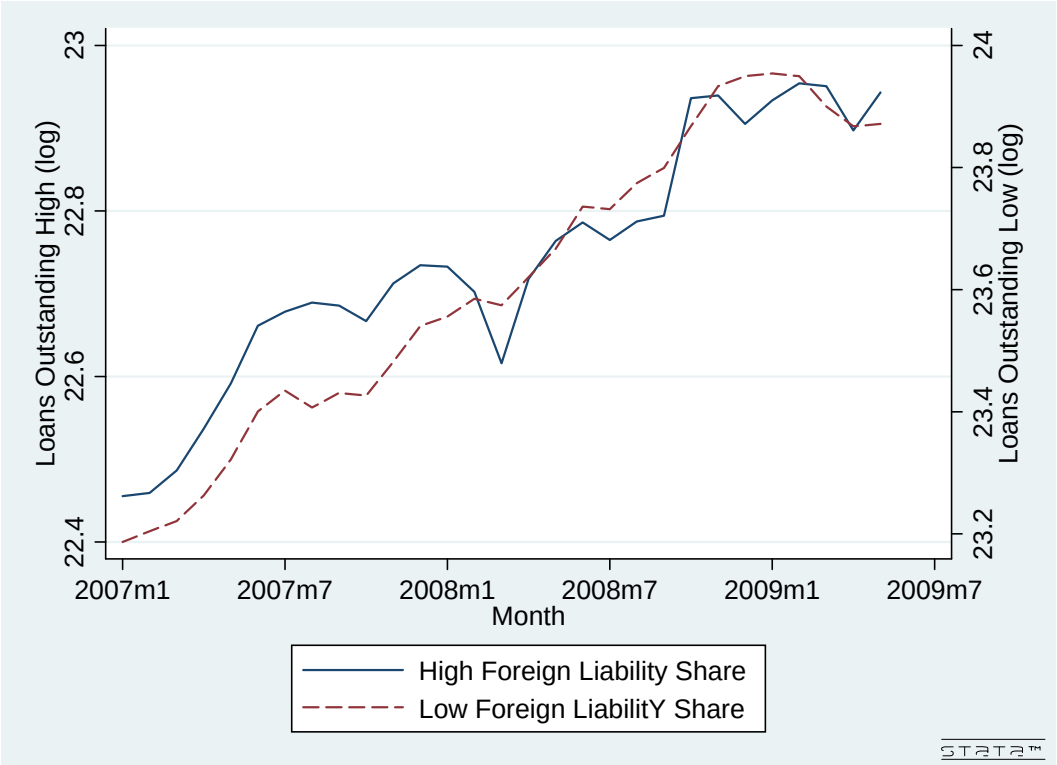
IV estimation of equation (7). $\Delta \ln C_i$ is instrumented with F_i, a dummy that takes value 1 if the firm borrows more than 50% from an affected bank. Product definition aggregated at 4-digit level according to the Harmonized System. Bootstrapped standard errors clustered at the product-destination level in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table A.1: Estimation Bias



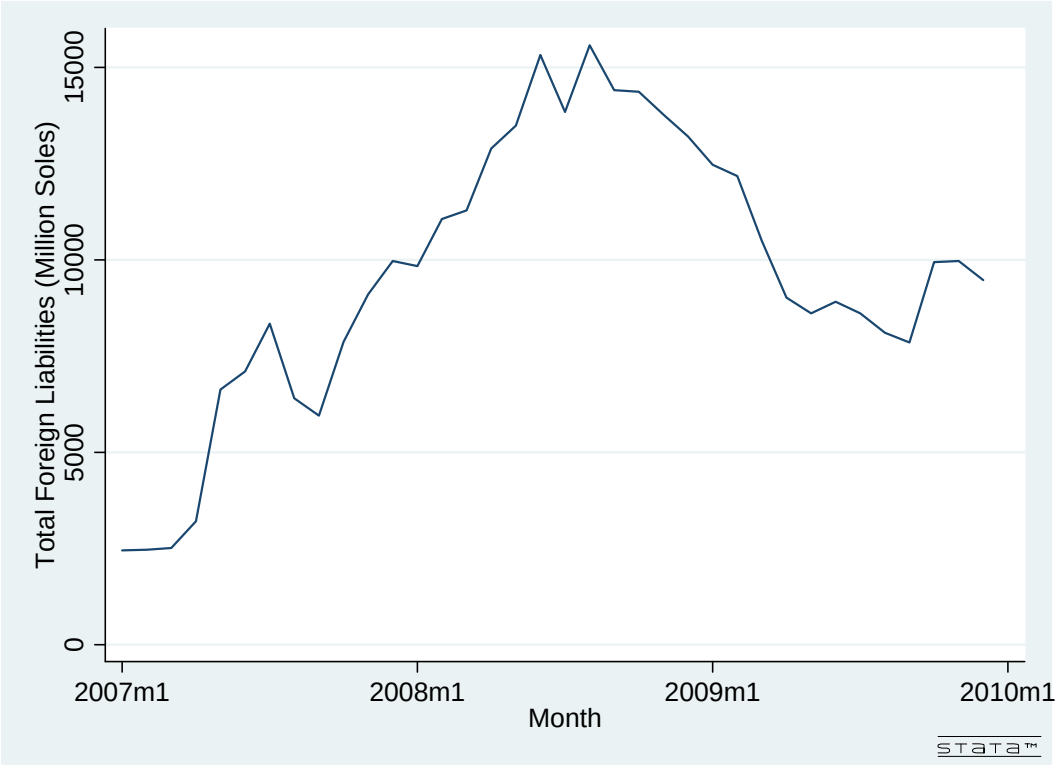
Source: SUNAT. Volume of exports in kg, and value in dollars FOB.

Figure 1: Total Peruvian Exports



Source: Bank Financial Statements and Credit Registry, Superintendencia de Bancos y Seguros de Peru, and SUNAT. Banks with high (low) foreign liability share are those with fraction of foreign liabilities to assets above (below) 9.5% in January-June 2008.

Figure 2: Lending by Banks with High Share of Foreign Liabilities



Source: Bank Financial Statements, Superintendencia de Bancos y Seguros de Peru. Foreign financing: bank liabilities with institutions outside Peru.

Figure 3: Total Banking Sector Foreign Financing

	All Comemercial Banks (N = 13)			High Foreign Exposure (N = 4)			Low Foreign Exposure (N = 9)		
	mean	sd	p50	mean	sd	p50	mean	sd	p50
Assets (M US$)	2,778	4,175	753	2,533	3,817	794	2,887	4,543	753
Loans (M US$)	1,668	2,379	507	1,709	2,575	562	1,650	2,451	507
Deposits (M US$)	1,979	3,060	465	1,681	2,682	436	2,112	3,359	465
Foreign Financing (M US$)	256	400	71	353	507	121	212	370	52
Loans/Assets	0.661	0.105	0.673	0.659	0.126	0.660	0.661	0.103	0.673
Deposits/Assets	0.637	0.142	0.691	0.573	0.082	0.543	0.665	0.158	0.733
Foreign Financing/Assets	0.095	0.101	0.068	0.196	0.135	0.175	0.050	0.034	0.065

Source: Bank Financial Statements as of December 2007, Superintendencia de Bancos y Seguros de Peru.

Table 1: Commercial Bank Descriptive Statistics

	All Exporters			Analysis Sample: Positive Debt after June 2008								
				Full Subsample			Borrows > 50% from Affected Banks					
							Yes			No		
	(N = 6,169)			(N=4,974)			(N = 1,303)			(N=3,671)		
	mean	sd	p50	mean	sd	p50	mean	sd	p50	mean	sd	p50
Debt (1,000 US$)	734	5,122	1	909	5,691	7	1,197	6,258	99	806	5,473	0
# Lenders	1.75	1.15	1.12	1.80	1.17	1.20	2.01	1.12	1.89	1.68	1.18	1.00
Fraction Dollar Debt	0.708	0.385	0.951	0.713	0.381	0.953	0.779	0.335	0.980	0.669	0.404	0.926
Exports - FOB (1,000 US$)	3,189	50,150	27	3,816	55,627	29	3,402	30,171	89	3,962	62,209	20
Exports (1,000 Kg)	8,529	230,792	11	10,449	256,985	12	5,483	40,747	38	12,212	298,141	9
# destinations	2.7	4.3	1.0	2.9	4.5	1.0	3.5	5.2	2.0	2.6	4.2	1.0
Distance (km)	6,040	7,462	4,725	5,962	7,302	4,725	6,054	9,149	3,448	5,929	6,524	4,725
# products (4-digit)	5.3	9.4	2.0	4.7	8.2	2.0	4.6	7.4	2.0	4.7	8.5	2.0
# Product x Destinations	8.7	20.5	3.0	8.0	18.5	3.0	8.8	16.4	3.0	7.7	19.2	3.0
Shipment Size - FOB (1,000 US$)	149.6	2796.7	1.8	176.5	3110.5	2.0	142.6	1708.5	3.6	188.5	3466.7	1.7
Shipment Size (1,000 Kg)	272.3	8337.4	0.5	319.9	9280.1	0.6	208.9	1735.3	1.2	359.3	10800.0	0.5
# Shipments per year	1.9	2.0	1.0	1.9	2.0	1.0	2.2	2.2	1.0	1.9	1.9	1.0
> 50% debt in exposed bank	0.219			0.262			1.000			0.000		
Fraction debt in exposed bank	0.221	0.378	0.000	0.265	0.398	0.000	0.900	0.154	1.000	0.040	0.113	0.000

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:	$\Delta \ln C_{ib}$		
	All firms	Small ($< median\ X$)	Large ($> median\ X$)
	(1)	(2)	(3)
FD_b	-0.168***	-0.194***	-0.136***
	(0.046)	(0.049)	(0.049)
Firm FE	yes	yes	yes
Observations	10,336	6,349	3,987
R^2	0.630	0.669	0.557
R^2 adj	0.261	0.264	0.239
# banks	42	41	33
# firms	5157	3490	1667

Estimation of equation (5). FD_b is a dummy that signals whether foreign liabilities of bank b is above the median. 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 Banks with High Foreign Dependence

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

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:	$\Delta \ln C_i$	$\Delta \ln Vol_{ipd}$			$\Delta \ln FOB_{ipd}$		
	FS	RF	OLS	IV	RF	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel 1: Products defined at 4-digit HS			
Dummy Affected: $> 50\%$	-0.561***	-0.127**			-0.144**		
	(0.192)	(0.058)			(0.062)		
$\Delta \ln C_i$			0.025	0.227***		0.035*	0.257***
			(0.018)	(0.068)		(0.020)	(0.060)
Product-Destination FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Product-Destinations	5,997	5,997	5,997	5,997	5,997	5,997	5,997
Observations	14,208	14,208	14,209	14,210	14,210	14,210	14,210
R^2	0.360	0.438	0.438		0.437	0.437	
				Panel 2: Products defined at 6-digit HS			
Dummy Affected: $> 50\%$	-0.636**	-0.133*			-0.155**		
	(0.250)	(0.071)			(0.076)		
$\Delta \ln C_i$			0.029	0.209***		0.044**	0.249***
			(0.019)	(0.060)		(0.021)	(0.058)
Product-Destination FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
# Product-Destinations	8,567	8,567	8,567	8,567	8,567	8,567	8,567
Observations	16,472	16,472	16,472	16,472	16,472	16,472	16,472
R^2	0.447	0.529	0.528		0.525	0.524	

Estimation of equation (7). In the IV regression, the change in (log of) credit, $\Delta \ln C_i$, is instrumented with F_i, a dummy that takes value 1 if the firm borrows more than 50% from an affected bank. Bootstrapped 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: Intensive Margin

Dependent Variable:	$\Delta \ln(ShipFreq_{ipd})$ (1)	$\Delta \ln(ShipVol_{ipd})$ (2)	$\Delta \ln(ShipFOB_{ipd})$ (3)
$\Delta \ln(C_i)$	0.140***	0.087	0.116**
	(0.030)	(0.054)	(0.052)
Product-Destination FE	Yes	Yes	Yes
Observations	14,208	14,208	14,208

IV estimation of equation (7). Dependent variable in columns 1 is the (log of) frequency of shipments, in columns 2 and 3 it is the (log of) average size of shipments (in volume and value, resp.). The change in (log of) credit, $\Delta \ln C_i$, is instrumented with F_i, a dummy that takes value 1 if the firm borrows more than 50% from an affected bank. Bootstrapped standard errors clustered at the product-destination level in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 6: Credit Elasticities of the Frequency and Size of Export Shipments

Dependent Variable:	$\Delta \ln N^E_{Fpd}$		$\Delta \ln N^C_{Fpd}$	
	4-digit HS (1)	6-digit HS (2)	4-digit HS (3)	6-digit HS (4)
$\Delta \ln(\sum_{i \in F} C_i)$	0.232	0.594	0.363***	0.275***
	(0.185)	(0.435)	(0.095)	(0.065)
Product-Destination FE	Yes	Yes	Yes	Yes
Observations	3,088	3,739	4,658	6,143

IV estimation of equation (8). Change in (log of) credit, $\Delta \ln C_i$, is instrumented with F_i, a dummy that takes value 1 if the firm borrows more than 50% from an affected bank. Bootstrapped standard errors clustered at the product-destination level in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 7: Export Elasticity to Credit Shocks: Extensive Margin

Dependent Variable:	Intensive Margin		Extensive Margin	
	$\Delta \ln Vol_{ipd}$	$\Delta \ln FOB_{ipd}$	ΔN^E_{Fpd}	ΔN^C_{Fpd}
	(1)	(2)	(3)	(4)
Panel 1:	Controlling for Observable Firm Characteristics			
$\Delta \ln C_i$	0.227***	0.249***		
	(0.070)	(0.074)		
$\Delta \ln(\sum_{i \in F} C_i)$			0.473	0.394***
			(0.337)	(0.122)
$\ln X$	-0.041**	-0.024	0.153	-0.004
	(0.017)	(0.017)	(0.156)	(0.012)
ln dollar debt	0.135*	0.110	-0.061	-0.019
	(0.069)	(0.069)	(0.119)	(0.031)
unit price	0.000	0.000	0.390*	-0.017
	(0.000)	(0.000)	(0.213)	(0.039)
ln # products	0.002	-0.003	1.096	-0.023
	(0.020)	(0.021)	(1.030)	(0.125)
ln # destinations	0.057*	0.041	0.000	-0.000
	(0.034)	(0.032)	(0.001)	(0.000)
# Product-Destinations	5,956	5,956	3916	4658
Observations	14,024	14,024	3088	5827
Panel 2:	Placebo Test			
$\Delta \ln C_i$	0.059	0.010		
	(0.352)	(0.342)		
$\Delta \ln(\sum_{i \in F} C_i)$			0.476	-0.180
			(0.299)	(0.318)
# Product-Destinations	6,046	6,046	3,104	4,758
Observations	15,265	15,265	4,003	5,990
Panel 3:	Alternative Instrument Functional Form			
$\Delta \ln C_i$	0.195***	0.217***		
	(0.048)	(0.050)		
$\Delta \ln(\sum_{i \in F} C_i)$			0.232	0.327***
			(0.185)	(0.079)
# Product-Destinations	5,997	5,997	3,088	4,658
Observations	14,210	14,210	3,916	5,827
Product-Destination FE	Yes	Yes	Yes	Yes

IV estimations of equations (7) and (8). Panel 1 adds the following firm level controls: overall volume of export, fraction of dollar debt, unit price of exports, number of products exported, and number of destinations. For the intensive margin, the controls are at the firm level; for the extensive margin they correspond to the group average. In Panel 2, $t = \{Pre - 1, Pre\}$, where Pre = June 2007-July 2008 and $Pre - 1$ = June 2006-July 2007. In Panel 3, the change in (log of) credit, $\Delta \ln C_i$, is instrumented with F_i: (max) proportion of firm debt in affected banks. Bootstrapped 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:	Intensive Margin		Extensive Margin	
	$\Delta \ln Vol_{ipd}$	$\Delta \ln FOB_{ipd}$	$\Delta \ln N^E_{Fpd}$	$\Delta \ln N^C_{Fpd}$
	(1)	(2)	(3)	(4)
Panel 1:	Size of Overall Exports			
$\Delta \ln C_i$	0.154*	0.181**		
	(0.091)	(0.091)		
$\Delta \ln C_i \cdot Large_i$	0.078	0.089		
	(0.162)	(0.169)		
$\Delta \ln(\sum_{i \in F} C_i)$			-2.223	0.127**
			(3.904)	(0.060)
$\Delta \ln(\sum_{i \in F} C_i) \cdot Large_{i \in F}$			2.068	0.276*
			(4.292)	(0.158)
Size-Product-Destination FE	Yes	Yes	Yes	Yes
Observations	14208	14218	3289	6447
Panel 2:	Multiple Banking Relationships			
$\Delta \ln C_i$	0.145**	0.202***		
	(0.067)	(0.071)		
$\Delta \ln C_i \cdot ManyBanks_i$	0.809	0.751		
	(0.732)	(0.669)		
$\Delta \ln(\sum_{i \in F} C_i)$			0.450***	0.234
			(0.143)	(0.343)
$\Delta \ln(\sum_{i \in F} C_i) \cdot ManyBanks_{i \in F}$			-0.303	3.253
			(0.271)	(6.958)
#Banks-Product-Destination FE	Yes	Yes	Yes	Yes
Observations	14,208	14,218	2444	5618

IV estimations of equations (7) and (8). The change in (log of) credit, $\Delta \ln C_i$, is instrumented with F_i, a dummy that takes value 1 if the firm borrows more than 50% from an affected bank. In Panel 1, credit is interacted with the dummy $Large_i$ that takes value 1 if the firm's total exports is above the median. Panel 2, the interacting dummy $ManyBanks_i$ takes value 1 if the number of banks that lend to the firm is larger than the median. Bootstrapped standard errors clustered at the product-destination level in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 9: Elasticity by Firm Characteristics

Dependent Variable:	Intensive Margin		Continuation Margin
	$\Delta \ln Vol_{ipd}$	$\Delta \ln FOB_{ipd}$	$\Delta \ln N^{C}_{Fpd}$
	(1)	(2)	(3)
Panel 1:	Size of Export Flow		
$\Delta \ln C_i$	0.239**	0.284***	
	(0.107)	(0.103)	
$\Delta \ln C_i \cdot Large_{ipd}$	-0.136	-0.151	
	(0.152)	(0.136)	
$\Delta \ln(\sum_{i \in F} C_i)$			0.543***
			(0.206)
$\Delta \ln(\sum_{i \in F} C_i) \cdot Large_{ipd \in F}$			-0.391*
			(0.228)
Size-Product-Destination FE	Yes	Yes	Yes
Observations	14208	14218	3289
Panel 2:	Distance to Destination Market		
$\Delta \ln C_i$	0.294***	0.350***	
	(0.077)	(0.077)	
$\Delta \ln C_i \cdot FarDest_{ipd}$	-0.172	-0.232	
	(0.152)	(0.146)	
$\Delta \ln(\sum_{i \in F} C_i)$			0.377**
			(0.151)
$\Delta \ln(\sum_{i \in F} C_i) \cdot FarDest_{ipd \in F}$			-0.231
			(0.170)
Distance-Product-Destination FE	Yes	Yes	Yes
Observations	14,146	14,156	6324

IV estimations of equation (7) and (8). The change in (log of) credit, $\Delta \ln C_i$, is instrumented with F_i, a dummy that takes value 1 if the firm borrows more than 50% from an affected bank. In Panel 1, credit is interacted with dummy $Large_{ipd}$ that takes value 1 if firm's exports of product p to destination d is above the median flow of the same product-destination. In Panel 2, the interacting dummy $FarDest_{ipd}$ is 1 if distance to the market d for export flow ipd is larger than the median distance. Bootstrapped standard errors clustered at the product-destination level in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 10: Elasticity by Export Flow Characteristic

	ΔVol_{ipd} (1)	ΔFOB_{ipd} (2)
Panel 1:	External Finance Dependence	
$\Delta \ln(C_i)$	0.211**	0.257***
	(0.083)	(0.080)
$\Delta \ln(C_i) \cdot HighFinDep_p$	-0.004	-0.008
	(0.169)	(0.163)
Observations	12,652	12,662
Panel 2:	Trade Credit	
$\Delta \ln(C_i)$	0.200**	0.215***
	(0.075)	(0.072)
$\Delta \ln(C_i) \cdot HighFinDep_p$	0.104	0.157
	(0.190)	(0.179)
Observations	14,208	14,218
Panel 3:	Vertical Linkages	
$\Delta \ln(C_i)$	0.206***	0.251***
	(0.077)	(0.074)
$\Delta \ln(C_i) \cdot Downstream_p$	0.080	0.022
	(0.193)	(0.171)
Observations	14,208	14,218
Panel 4:	Elasticity of Substitution	
$\Delta \ln(C_i)$	0.173*	0.243***
	(0.101)	(0.090)
$\Delta \ln(C_i) \cdot HighElastSubst_p$	0.103	-0.011
	(0.148)	(0.138)
Observations	14035	14045
Product-Destination FE	Yes	Yes

IV estimation of equations (7). The change in (log of) credit, $\Delta \ln C_i$, is instrumented with F_i, a dummy that takes value 1 if the firm borrows more than 50% from an affected bank. The classification of sectors according to their dependence of external finance and share of tangible assets follows Chor and Manova (2010). The downstream index is from Levchenko et al. (2010), and the elasticity of substitution from Broda and Weinstein (2006). Bootstrapped standard errors clustered at the product-destination level in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 11: Elasticity by Product Characteristic