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

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Abstract

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. A 10% decline in credit reduces by 2.3% the intensive margin of exports, by 3.6% the number of firms that continue supplying a product-destination, but has no effect on the entry margin. Overall, credit shortages explain 15% of the Peruvian exports decline during the 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 (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. Motivated by the unprecedented drop in world exports during the 2008 financial crisis, this debate permeated to international trade: Do bank funding shortages affect export performance of their 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 effect of funding shocks to Peruvian banks on exports during the 2008 financial crisis. Peru offers an ideal setting to address the crucial identification problem that typically hinders the characterization of the effect of credit on real economic outcomes: how to disentangle the effect of credit supply on output from changes in credit demand in response to factors affecting firms' production decisions (i.e. demand, input prices). First, although local banks and firms were not directly affected by the drop in the value of U.S. real estate, funding to domestic banks was negatively affected by the reversal of capital flows. The funding shortage was particularly pronounced among banks with a high share of foreign liabilities. We use this heterogeneity as a source of variation for the supply of credit to related firms. And second, data availability makes it possible to match firm level credit registry data on the universe of bank loans in Peru with customs data on the universe of Peruvian exports. The main novelty of these data is that they allow us to estimate the elasticity of exports to credit after controlling for determinants of exports at the product-destination level.

Our empirical strategy exploits the detail of the customs data by comparing the export

growth of the *same* product and to the *same* destination by firms that borrow from banks that were subject to 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.*.[1] Suppose that one of the firms obtains all its credit from Bank A, which had a large funding shock, while the other firm obtains its credit from Bank B, which did not. Changes in the demand for overcoats or the financial conditions of the 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, 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 isolates the effect of credit on exports. We use an instrumental variable approach based on this intuition to estimate the credit elasticity of the intensive and extensive margins of export.

Accounting for the determinants of exports at the product-destination level is crucial when studying the real effects of the bank transmission channel during international crises, when shocks to banks are potentially correlated to shocks to their borrowers. Existing work, restricted by data availability to studying firm level outcomes (e.g. total sales, total exports, investment), has relied on the assumption that shocks to firms and banks are orthogonal.[2] We show that this assumption does not hold in our context. We find that banks most affected by the crisis specialize in lending to firms that export to product-destination markets disproportionately shocked by factors other than bank credit. Then, if orthogonality is assumed in our context, the effect of credit credit supply shock on exports is severely overestimated. The bias resulting from the orthogonality assumption

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

[2]See for example Amiti and Weinstein (2009), Carvalho, Ferreira and Matos (2010), Iyer, Lopes, Peydro and Schoar (2010), Jimenez, Mian, Peydro and Saurina (2010), Kalemli-Ozcan, Kamil and Villegas-Sanchez (2010). Earlier studies, such as Peek and Rosengren (2000), and Ashcraft (2005), look at outcomes aggregated at the State or County level.

is potentially important during crisis episodes, which have large and heterogeneous real effects across sectors and countries, as recently emphasized in Alessandria, Kaboski and Midrigan (2010), Bems, Johnson and Yi (2010), Eaton, Kortum, Neiman and Romalis (2010), Levchenko, Lewis and Tesar (2010), and Antras and Foley (2011).

The results on the credit elasticity of trade are as follows. On the intensive margin, we find that a 10% reduction in the supply of credit results in a contraction of 2.3% 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 0.12, respectively. On the extensive margin, credit supply affects the number of firms that continue exporting to a given market, with an elasticity of 0.36. This effect is particularly important for small export flows: a 10% decline in the supply of credit reduces the number of firms exporting to a product-destination by 5.4%, if the initial export flow volume was below the median. The credit shock does not significantly affect the number of firms entering an export market.

We use these estimates to assess the importance of the credit shortage in explaining the decline in Peruvian exports during the crisis. Peruvian exports volume growth was -9.6% during the year following July 2008, almost 13 percentage points lower than the previous year (see Figure 1). We estimate, using the within-firm estimator in Khwaja and Mian (2008), that the supply of credit by banks with above average share of foreign liabilities declined by 17% after July 2008. Together with the estimated elasticities of exports to credit, this implies that the credit supply decline accounts for about 15% of the missing volume of exports. Thus, while the credit shortage has a first order effect on trade, the bulk of the decline in exports during the analysis period is explained by the

drop in international demand for Peruvian goods.

The findings in this paper provide new insights on the relationship between the production function and the use of credit of exporting firms. Consider, for example, the benchmark model of trade with sunk entry costs.[3] In such a framework, a negative credit shock affects the entry margin, but once the initial investment is covered, credit fluctuations do not affect the intensive margin of trade or the probability of exiting an export market. However, we find positive elasticities both in the intensive and continuation margins. Our results thus suggest that credit shocks affect the *variable* cost of producing and are consistent with the presence of a fixed cost of exporting. This would be the case, for example, if banks finance exporters' working capital, as in Feenstra, Li and Yu (2011). By increasing the unit cost of production, adverse credit conditions reduce the equilibrium size and profitability of exports. In combination with fixed costs, the profitability decline induces firms to discontinue small export flows, which are closer to the break-even point.

We explore whether our results pertain to the financing of working capital that is specific to export activities, as opposed to the firm's general funding needs. We test the usual assumption that exports require additional working capital when freight times are longer.[4] The estimated elasticity of exports to credit does not vary with distance to the destination market, our proxy for freight time. This suggests that export-specific working capital requirements do not have a significant effect on the elasticity of exports to credit. Our result diverges from recent findings based on cross-product or cross-country comparisons (Amiti and Weinstein (2009) and Chor and Manova (2010)). We show that the failure to control for determinant of exports at the product-destination level discussed

[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.

[4]See Hummels (2001), Auboin (2009), and *Doing Business* by the World Bank, and Ahn (2010) and Schmidt-Eisenlohr (2010) for theory leading to that prediction.

above can explain the divergence in our context: When we aggregate exports at the firm level and do not account for product-destination shocks, the credit shortage appears to affect disproportionately exports to more distant destinations. However, this heterogeneity is fully explained by the fact that non-credit factors affect disproportionately exports to distant markets during the 2008 crisis.[5]

Our estimates correspond exclusively to the elasticity of exports to short-run credit fluctuations. Other studies have found that long-term finance availability also affects trade: countries with developed financial markets have a comparative advantage in sectors characterized by large initial investments (see Beck (2003) and Manova (2008)).[6] We explore whether factors found to affect the sensitivity of exports to long-term financial conditions can also predict the effect of short-term credit shocks. We find that the elasticity of exports to credit shocks is constant across sectors with different external finance dependence, measured as in Rajan and Zingales (1998). This result suggests that the elasticity to long-term and short-term changes in financial conditions reflect different aspects of the firm's use of credit. The former varies with the firm's technological requirements of capital in sectors characterized by important entry costs or fixed investments. The latter is related to the funding of working capital. They are complementary parameters that characterize 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, Amiti and Weinstein (2009), Bricongne, Fontagne, Gaulier, Taglioni and Vicard (2009), Iacovone and Zavacka (2009), and Chor and Manova (2010)). This literature recovers reduced form estimates that cannot be linked to meaningful structural parameters. Our empirical approach and data allow us to present the first estimates

[5]This is consistent with the evidence in Eaton, Eslava, Kugler and Tybout (2008) that distant markets often are the marginal destination of the firm and the first ones to be abandoned.

[6]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.

for the elasticity of exports to credit. Such estimates are important because they can be used to parameterize quantitative analysis. These are key to assess the role of credit in explaining export variation across firms, across sectors, and in the time series.

The results emphasize the role played by commercial banks in the international transmission of financial shocks to emerging economies. This channel has been shown to affect credit supply in times of international capital reversals, and is believed to be an important source of contagion during the 2008 crisis (see Cetorelli and Goldberg (2010) and IMF (2009)).[7] This paper adds to this research by estimating the effect of such a transmission channel on real economic outcomes.

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. In 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 perform a back of the envelope calculation of the contribution of the credit channel to the drop in Peruvian exports during the 2008 crisis. Section 7 concludes.

2 Data Description

We use three data sets: 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, and Pension Funds (SBS). All data are public information.

We collect the customs data from the website of the Peruvian tax agency (Superin-

[7]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. See, for example, Kashyap and Stein (2000), Ashcraft (2005), Ashcraft (2006), Gan (2007), Khwaja and Mian (2008), Paravisini (2008), Chava and Purnanandam (2011), Iyer and Peydro (2010), and Schnabl (2010).

tendence 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 the SUNAT for tax collection purposes.

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.[8] 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 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 2008 financial crisis. 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

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

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 2008 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 at an average distance of 6,040 kilometers (out of a total of 198 destinations). 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 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. 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 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:

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

Our empirical strategy to address this problem has two components. 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 in firms producing certain products or exporting to given destination markets, the instrument may be unconditionally correlated to factors that affect exports 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 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.

To avoid potential bias due to non-random matching of firms and banks, a second component 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. 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 during the crisis are not related to the banks 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.[9] Such a correlation between bank affiliation and idiosyncratic shocks to exports of the same product and to the same destination is unlikely. To corroborate this, we show 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.

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, 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.

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}.

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

We explain the economic rationale behind the instrument, and discuss the identification hypothesis behind the instrumental variable (IV) estimation next.

3.1 Bank Foreign Liabilities and the Supply of Credit during the 2008 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.

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 2). This capital flow reversal disproportionately affected banks with a high share of foreign liabilities. As we formally demonstrate below, lending by banks with above the median foreign liabilities to assets dropped disproportionately more during 2008.[10] 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.[11]

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%).

Of the thirteen commercial bank in the sample, four are classified as exposed.[12] Both

[10]See Banco Central de Reserva del Peru (2009) for an analysis of the performance of the domestic financial market during the 2008 crisis.

[11]Subsection 4.3 shows that results are robust to setting the turning point in April 2008, after the collapse of Bearn Stearns.

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

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% 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. By definition, 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 Identification Hypothesis: Foreign Liabilities and Credit Supply

The hypothesis behind the instrumental variable specification is that banks with larger fraction of their funding from foreign sources reduce the supply of credit relative to other banks after the crisis. 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 the 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. FD_b is a dummy that takes value one for *affected* banks — i.e. 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.

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

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 the aggregate volume of exports (in kilograms) of product p to destination d by firm i in the period $t = \{Pre, Post\}$. The resulting estimation equation is:

$$\ln(X_{ipdPost}) - \ln(X_{ipdPre}) = \alpha'_{pd} + \eta \cdot [\ln(C_{iPost}) - \ln(C_{iPre})] + \varepsilon'_{ipd} \tag{6}$$

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 the Instrumental Variable (IV) estimation of the export elasticity to credit supply in specification (6) are presented in Table 5, column 3. The IV estimate im-

plies that a 10% increase in the stock of credit results in an increase of 2.3% in the volume of yearly export flows (Panel 1). 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). Following the example above, this further disaggregation implies comparing firms' exports of *Men's Cotton Overcoats*, instead of *Men's Overcoats*. The results imply that the estimated magnitude of the elasticity is 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. Two factors are potentially behind this bias. First, the credit supply shock explains only a small portion of the overall drop in credit. Instead, firms' demand of credit dropped disproportionately more than exports during the period under analysis. And second, the attenuation bias of the OLS estimate is likely of first order, given that the regression is in differences and it includes a number of fixed effects (see Arellano (2003)).

During the period under analysis, it is crucial to control for export demand. Subsection 4.4 discusses the reduced form estimates (presented in Table 8) and shows that not controlling for common fluctuations in exports at the product-destination level would lead to overestimate the effect of the credit shock on the drop in exports during the 2008 crisis by 95%.

We compute the effect of credit on the size and frequency of the firm's export shipments. We estimate equation (6) 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 second 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 a given product-destination market. 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 ($G = \{1, 0\}$) according to their exposure to credit shocks: those with at least 50% of their debt with affected banks (group $G = 1$) and those with most of their debt with non affected banks (group $G = 0$). Then we estimate the following equation:

$$\ln N_{Gpdt} = \delta_{Gpd} + \alpha_{pdt} + \nu \cdot \ln \left(\sum_{i \in G} C_{it} \right) + \xi_{Gpdt} \tag{7}$$

To study the entry margin, we use as the left-hand side variable the number of firms in group G that start exporting product p to destination d at time t, for $t = \{Pre, Post\}$ (N^E_{Gpdt}). To study the continuation margin, we use the number of firms in group G 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_{Gpdt}).

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 G at time t, $\ln(\sum_{i \in G} C_{it})$. Similar to the instrument definition in equation (4), we instrument debt of firms in group G with a function F_{Gt} that predicts the credit supply

to the firms in group G based on the external dependence of its related banks: $F_{Gt} = 1$ if $F_{it} = 1$ for $i \in G$ (firms with at least 50% of their debt in affected banks) and zero otherwise.

We include product-destination-time dummies, α_{pdt}, that control for changes in demand and productivity. This specification differs from the one in (6) in that the unit of observation is defined at the group-product-destination level. The fixed effects δ_{Gpd} control for any time-invariant heterogeneity of exports of product p to destination d by firms in group G, instead of controlling at the firm-product-destination level as in specification (6).

We estimate the parameter ν after first differencing equation (7) to eliminate the group-product-destination fixed effects. The dependent variables are therefore $\Delta \ln N^E_{Gpdt}$ and $\Delta \ln N^C_{Gpdt}$, respectively.

The entry margin results are presented in Table 5, column 6, 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. Column 8 shows the results concerning the continuation margin. According to our preferred specification, using product definition aggregated at 4-digit level (Panel 1), a 10% increase in the stock of credit increases the number of firms continuing exporting a given product-destination flow in 3.6%. The estimate of the continuation elasticity drops from 0.36 to 0.275 when export markets are defined at the 6-digit HS level (Panel 2). This potentially reflects that the misclassification of exports into 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 five identification tests. The first two tests relate to potential unaccounted shocks correlated with bank affiliation. In the first test we compare the elasticity of exports to credit using value and volume of exports as dependent variable. The second test estimates the export elasticity controlling for observable firm characteristics. The third test checks that the results are not sensitive to the exact definition of the *Pre* and *Post* periods. Fourth, we test for pre-existing differential trends in the export and borrowing behavior of firms linked with exposed and non-exposed banks. Finally, the fifth test evaluates the robustness of the estimated elasticities to the instrument definition.

As we 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 affected banks export products of a higher quality (within the same 4 or 6 digit HS code), 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. We conduct two sets of tests to investigate this possibility.

First, we estimate the export elasticity in the intensive margin measuring exports in dollar FOB values. 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 7 confirms that the volume and value elasticities are of the same order of magnitude and statistically indistinguishable.

An alternative way to test for unaccounted shocks correlated with bank affiliation is to explicitly control for them. We augment equation (6) 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 of equation (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 2, Table 7) are virtually identical to those computed without controls.

The 2008 financial crisis does not have an objective initial date. The turning point used in the baseline regression, July 2008, is based on the evolution of foreign capital inflows in Peru. However, domestic banks may have anticipated it after the collapse of Bearn Stearns and the increase in international financial volatility in March 2008. We check that our results are robust to setting the turning point in April 2008. The elasticity of the intensive margin is 0.25 in this case. The continuation margin is elastic to credit, the point estimate of the elasticity is larger than in the benchmark specification (0.65), but the regression is substantially noisier (s.d. 0.33). Again, the elasticity of the entry margin is not statistically different from zero.

In the fourth 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 (6) 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 3 of Table 7, are not statistically different from zero.[13] 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.

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 similar to those described above, are presented in Panel 4 of Table 7.

Overall, the results in Table 7 suggest that our instrument satisfies the exclusion restriction and it correctly identifies the effect of credit supply shocks to the firms during the 2008 crisis.

4.4 Reduced Form and Estimation Bias

Recent work studying real effects of the bank transmission channel during crises has been constrained by data limitations to studying firm level outcomes, such as total sales, total exports, or investment (see for example Amiti and Weinstein (2009), Carvalho et al. (2010), Iyer et al. (2010), Jimenez et al. (2010), Kalemli-Ozcan et al. (2010)). The typical

[13]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 our instrumental variable approach.

empirical strategy compares outcomes of firms related to banks that are differentially affected by the crisis. If the match between firms and banks is random, such comparison provides an unbiased reduced form estimation of the bank transmission channel. This strategy will produce biased estimates, however, if banks and firms are not randomly matched. In our case, for example, firms related to affected banks may specialize in certain products or destinations. Then, estimations based on comparing the outcomes of firms related to affected and non affected banks confound the effect of the lending channel with the heterogeneous impact of the crisis across products and destinations.

This subsection computes the bias that arises when we aggregate the data at the firm level and use it to obtain a difference-in-differences estimate that compares the change in average exports by firms borrowing from affected banks relative to firms borrowing from non-affected banks (parallel to the reduced form estimates in the above mentioned studies). We present in Table 8, column 1, the naive difference-in-differences reduced form estimate (with firm fixed effects), and in column 2, the reduced form version of equation (6), which controls for shocks at the product-destination level.[14] The difference-in-differences estimator in column 1 overestimates the reduced form effect of the credit shock on exports during the 2008 crisis by 95%. This finding implies that firms and banks are not randomly matched. In particular, exposed banks specialize in destinations that are disproportionately affected by the financial crisis.[15]

These results call for caution when deriving conclusions based on comparisons across sectors or destinations. For example, conclusions regarding the specific usage of credit by export activities often rely on comparing the effect of a credit shock on the firm's sales across destinations; i.e., domestic versus foreign sales, or across foreign destinations with

[14]The reduced form is the regression of exports on the instrument. Intuitively, the difference in export growth to a product-destination market by firms related by affected and non-affected banks, controlling for shocks at the product-destination level.

[15]The bias is largest when there are no controls for fluctuations at destination.

different freight time. These comparisons may confound the effect of the credit shock on exports with the heterogeneous impact of the crisis across markets.

To illustrate this point, we replicate the exercise in Amiti and Weinstein (2009) and compare the effect of the credit shock across exports flows of different freight time. We proxy freight time by the distance in kilometers between Peru's capital city and the destination market.[16] In columns 3 and 4 of Table 8 we augment the specifications in columns 1 and 2 with an interaction between the firm exposure dummy and a far destination dummy ($FarDest$). In the specification using data aggregated at the firm level (column 3), $FarDest_i = 1$ if the destination of the firms' largest export flow is above the median destination distance (2,900 kilometers). In the specification using firm-product-destination level data (column 2), $FarDest_{ipd} = 1$ if destination d is above the median destination distance.

Without controlling for potential heterogenous shocks in the destination market, the estimate in column 3 would suggest credit affects only exports to farther destinations. Amiti and Weinstein (2009) obtain the same result using firm level data from Japan.[17] However, once product-destination shocks are accounted for, the conclusion is reversed: the credit shock reduces disproportionately exports to closer destinations. Unaccounted demand shocks can not only lead to a biased estimate of the effect of credit on exports, but can also lead to incorrect inferences about the heterogeneity of the effect of the crisis in the cross section of exporters.

It is important to emphasize, in addition, that even unbiased reduced form estimates cannot be used to characterize the cross sectional heterogeneity in the sensitivity of exports to finance. For example, the above result may be driven by the fact that banks cut credit

[16] Amiti and Weinstein (2009) does not have destination data and must approximate freight time with a proxy based on the product. Products typically shipped by air are assumed to have on average a shorter freight time than products shipped by sea.

[17] To compare our results with those in Amiti and Weinstein (2009), we follow their methodology and do not include *distance* as an independent control variable in column 3 of Table 8.

disproportionately to firms exporting to closer destinations during the crisis (e.g., smaller firms), and not because exports to closer destinations are more sensitive to changes in finance. We characterize this heterogeneity next.

5 Characterization of the Export Elasticity to Credit

In this section we analyze how the elasticity of exports to credit shocks varies according to observable characteristics of the exporting 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. Our results suggest a different interpretation.

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 (column 1). Neither does the entry margin elasticity (column 2). Only the continuation margin elasticity shows some cross sectional heterogeneity: the number continuing product-destination flows is more responsive to credit conditions for large exporters (column 3). This last result may be mechanically driven by the fact that large firms supply a larger number of product-destination markets.

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 the supply of 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. Then, a negative supply credit shock is expected to disproportionately affect the continuation margin for small export flows, for which export volume is 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 column 1) 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.

We explore whether our results pertain to the financing of working capital that is specific to export activities, as opposed to the firm's general financing needs. We test the usual assumption that exports require additional working capital when freight times are longer. Table 10, Panel 2, shows that the estimated elasticity of exports to credit does not vary with freight time, proxied by distance to the destination market as in subsection 4.4. This result does not support the hypothesis that export-specific financing requirements have a first order effect on the magnitude of the elasticity. Instead, the sensitivity to credit appears to emerge from the general working capital requirements by the firm, which becomes costlier after a negative credit shock, and affects sales irrespectively of their destination.

The elasticity result complements the reduced form estimate in Table 8, column 4, which indicates that firms related to affected banks drop exports disproportionately to *closer* destinations. With the results in Table 10, Panel 2, we can now conclude that the disproportionate decline in exports to closer destination is not driven by differences in the elasticity to credit. Instead, both results taken together suggest that the credit shortage was particularly severe for firms exporting to neighboring destinations. This is consistent with the results in Table 3: smaller firms, which tend to specialize in closer destination

markets, suffered larger credit shortages. Overall, these results emphasize the importance of obtaining elasticity estimates for understanding the economic forces behind the decline in trade during the crisis.

5.3 Sectorial Heterogeneity

In the United States, characterized by relatively frictionless financial markets, firms of different manufacturing 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 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, 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 (6) and (7) augmented with an interaction between all the right-hand side variables with a dummy equal to one if the product belongs to an industry with above median external financial dependence. The point estimates on the interaction term are negative in all specifications, and significantly different than zero in the continuation margin. This indicates that the elas-

ticity of the intensive margin of exports to credit shocks does not vary across sectors with different levels of external finance dependence. The continuation margin is *less* elastic for sectors with high 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 credit conditions, 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 often 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 elasticities estimated in the previous section vary for sectors with high share of trade credit. The point estimates are not statistically significant.

Finally, we analyze how the sensitivity to credit varies for commodities and differentiated goods. World exports of these types of goods behave differently during the 2008 crisis. Although quantities exported drop for all products and countries, their unit values present interesting differences: world commodity prices collapse while prices of differentiated goods do not (see Haddad, Harrison and Hausman (2001)). Credit constraints in the differentiated sector, by negatively affecting supply of exports, can rationalize this pattern. We explore this hypothesis by comparing the elasticity for homogeneous and differentiated goods, following the product classification in Rauch (1999). The point estimates in Panel 3 of Table 11 are consistent with this hypothesis. For homogenous goods, the continuation margin is significantly less sensitive to credit. In the case of the intensive

margin, however, the estimation is too noisy to be conclusive.[18]

6 Contribution of the Banking System 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%.

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 (Table 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 estimate characterizing the performance of large flows, 0.15. The entry 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%.

[18]Since less than 10% of Peruvian export flows involves differentiated products, this estimation is particularly noisy.

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 conclusive 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 2008 international 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.

The estimation strategy fully exploits the level of disaggregation of the export data and accounts for determinants of exports other than bank credit at the product-destination level. We show that, in our context, failure to control for these factors leads to severely biased estimates when studying the effect of a contraction in credit 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.

Existing theoretical models of finance and trade, in which firms use credit to finance sunk costs of entry in new export markets, cannot account for these patterns. 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 production —i.e. the cost of working capital. Then, adverse credit conditions reduce the equilibrium size of exports by increasing the marginal cost of producing. Moreover, our results suggest the existence of fixed costs of exporting (at the product-destination level). Then, an increase in the variable cost 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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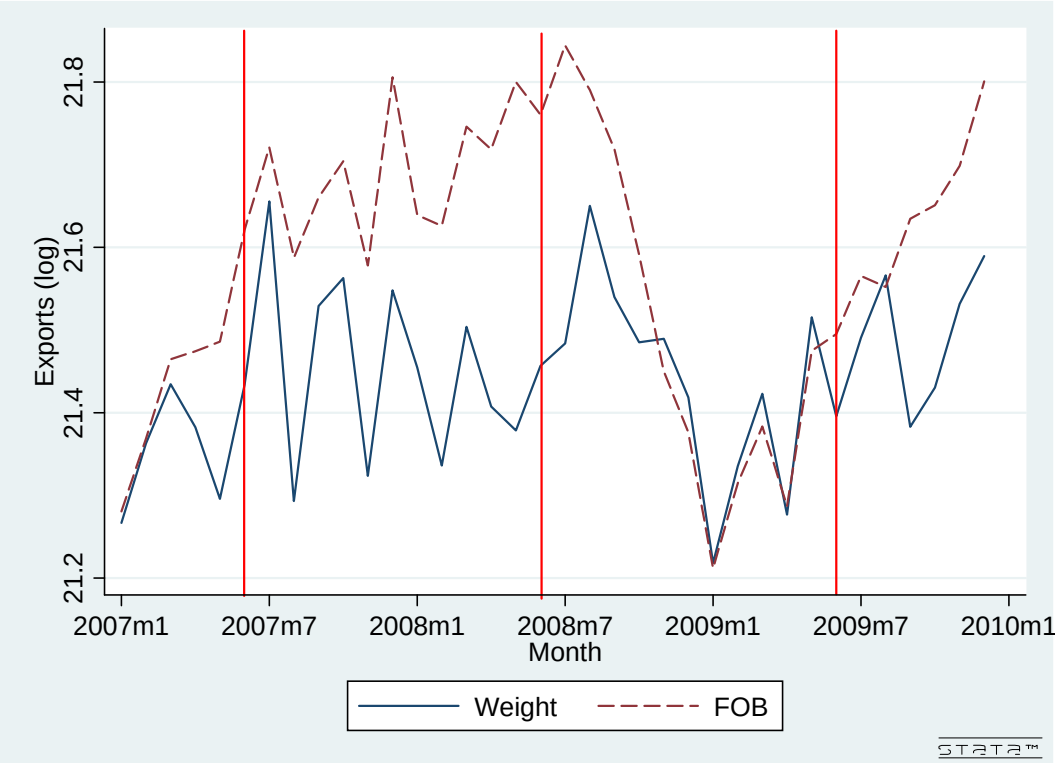
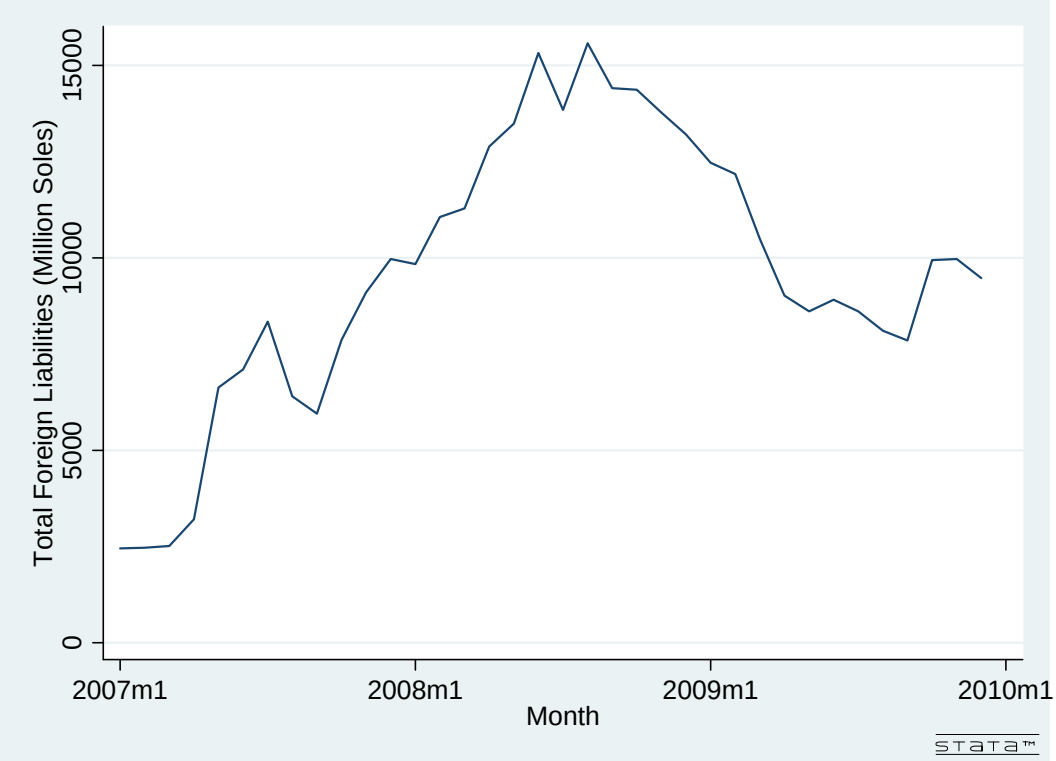


Source: SUNAT. Volume of exports in kg, and value in dollars FOB.

Figure 1: Total Peruvian Exports



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

Figure 2: 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:	Intensive Margin			Extensive Margin				
	$\Delta \ln C_i$	$\Delta \ln X_{ipd}$		$\Delta \ln(\sum_{i \in G} C_i)$	$\Delta \ln N^E_{Gpd}$		$\Delta \ln N^C_{Gpd}$	
	FS	OLS	IV	FS	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel 1:	Products defined at 4-digit HS							
Dummy Affected: $> 50\%$	-0.561***			-0.394**				
	(0.192)			(0.190)				
$\Delta \ln C_i$		0.025	0.227***					
		(0.018)	(0.068)					
$\Delta \ln(\sum_{i \in G} C_i)$					0.031**	0.232	0.015	0.363***
					(0.015)	(0.185)	(0.013)	(0.095)
Product-Destination FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,208	14,209	14,210	9,153	4,495	3,916	6,114	5,827
# Product-Destination	5,997	5,997	5,997	6,995	3,564	3,088	4,866	4,658
R^2	0.360	0.438		0.797	0.770		0.788	
Panel 2:	Products defined at 6-digit HS							
Dummy Affected: $> 50\%$	-0.636**			-0.439**				
	(0.250)			(0.204)				
$\Delta \ln C_i$		0.029	0.209***					
		(0.019)	(0.060)					
$\Delta \ln(\sum_{i \in G} C_i)$					0.046**	0.594	0.018	0.275***
					(0.019)	(0.435)	(0.015)	(0.065)
Product-Destination FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	16,472	16,472	16,472	12,285	5,212	4512	7,668	7,302
# Product-Destination	8,567	8,567	8,567	10,004	4,330	3,739	6,421	6,143
R^2	0.447	0.528		0.845	0.801		0.806	

Estimation of equations (6) and (7). In the IV regression, the change in (log of) credit, $\Delta \ln C_i$ ($\Delta \ln(\sum_{i \in G} C_i)$), is instrumented with F_i (F_G), a dummy that takes value 1 if the firm (firms in group G) borrows more than 50% from an affected bank. 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

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 (6). 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, $\Delta \ln C_i$ ($\Delta \ln(\sum_{i \in G} C_i)$), is instrumented with F_i (F_G), a dummy that takes value 1 if the firm (firms in group G) borrows more than 50% from an affected bank. 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:	Intensive Margin	Extensive Margin	
	$\Delta \ln X_{ipd}$	ΔN^E_{Gpd}	ΔN^C_{Gpd}
	(1)	(2)	(3)
Panel 1:	X_{ipd} is Value (FOB) of Exports		
$\Delta \ln C_i$	0.257***		
	(0.060)		
Observations	14,210		
Panel 2:	Controlling for Observable Firm Characteristics		
$\Delta \ln C_i$	0.227***		
	(0.070)		
$\Delta \ln(\sum_{i \in G} C_i)$		0.473	0.394***
		(0.337)	(0.122)
$\ln X$	-0.041**	0.153	-0.004
	(0.017)	(0.156)	(0.012)
ln dollar debt	0.135*	-0.061	-0.019
	(0.069)	(0.119)	(0.031)
unit price	0.000	0.390*	-0.017
	(0.000)	(0.213)	(0.039)
ln # products	0.002	1.096	-0.023
	(0.020)	(1.030)	(0.125)
ln # destinations	0.057*	0.000	-0.000
	(0.034)	(0.001)	(0.000)
Observations	14,024	3,088	5,827
Panel 3:	Placebo Test		
$\Delta \ln C_i$	0.059		
	(0.352)		
$\Delta \ln(\sum_{i \in G} C_i)$		0.476	-0.180
		(0.299)	(0.318)
Observations	15,265	4,003	5,990
Panel 4:	Alternative Instrument Functional Form		
$\Delta \ln C_i$	0.195***		
	(0.048)		
$\Delta \ln(\sum_{i \in G} C_i)$		0.232	0.327***
		(0.185)	(0.079)
Observations	14,210	3,916	5,827
Product-Destination FE	Yes	Yes	Yes

IV estimations of (6) and (7). In Panel 1, exports measured in US$ FOB. Panel 2 adds the following controls: overall volume of export, fraction of dollar debt, unit price of exports, # products exported, and # destinations. For intensive margin, controls are at firm level; for extensive margin they correspond to group average. In Panel 3, $t = \{Pre - 1, Pre\}$, where Pre = June 2007-July 2008 and $Pre - 1$ = June 2006-July 2007. In Panel 4, $\Delta \ln C_i$ instrumented with F_i: (max) proportion of firm debt in affected banks. Standard errors clustered at the product-destination level in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 7: Identification Tests

	Overall Effect		Distance	
Dependent Variable:	$\Delta \ln X_i$	$\Delta \ln X_{ipd}$	$\Delta \ln X_i$	$\Delta \ln X_{ipd}$
	(1)	(2)	(3)	(4)
Dummy Affected: $> 50\%$	-0.247***	-0.127**	-0.005	-0.254***
	(0.070)	(0.058)	(0.079)	(0.082)
Dummy Affected: $> 50\% \cdot FarDest$			-0.573***	0.210*
			(0.110)	(0.103)
Product-Destination FE	No	Yes	No	Yes
Observations	2,438	14,208	2,421	14,208
R^2	0.005	0.438	0.017	0.439

Reduced form estimation of equation (6). The instrument F_i is a dummy that takes value 1 if the firm borrows more than 50% from an affected bank. X_i and X_{ipd} are volume of exports at the firm and firm-product-destination levels, respectively. In column 3, the interacting dummy $FarDest$ is one if the distance to the firm's main export market is above the median. In column 4, $FarDest$ is one if the distance to the firm-product-destination market is larger than the median. In columns 2 and 4 standard errors are clustered at the product-destination level, in parenthesis. $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$

Table 8: Estimation Bias

Dependent Variable:	Intensive Margin	Extensive Margin	
	$\Delta \ln X_{ipd}$	$\Delta \ln N^E_{Gpd}$	$\Delta \ln N^C_{Gpd}$
	(1)	(2)	(3)
Panel 1:	Size of Overall Exports		
$\Delta \ln C_i$	0.154*		
	(0.091)		
$\Delta \ln C_i \cdot Large_i$	0.078		
	(0.162)		
$\Delta \ln(\sum_{i \in G} C_i)$		-2.223	0.127**
		(3.904)	(0.060)
$\Delta \ln(\sum_{i \in G} C_i) \cdot Large_{i \in G}$		2.068	0.276*
		(4.292)	(0.158)
Size-Product-Destination FE	Yes	Yes	Yes
Observations	14208	3289	6447
Panel 2:	Multiple Banking Relationships		
$\Delta \ln C_i$	0.145**		
	(0.067)		
$\Delta \ln C_i \cdot ManyBanks_i$	0.809		
	(0.732)		
$\Delta \ln(\sum_{i \in G} C_i)$		0.450***	0.234
		(0.143)	(0.343)
$\Delta \ln(\sum_{i \in G} C_i) \cdot ManyBanks_{i \in G}$		-0.303	3.253
		(0.271)	(6.958)
#Banks-Product-Destination FE	Yes	Yes	Yes
Observations	14,208	2444	5618

IV estimations of equations (6) and (7). The change in (log of) credit, $\Delta \ln C_i$ ($\Delta \ln(\sum_{i \in G} C_i)$), is instrumented with F_i (F_G), a dummy that takes value 1 if the firm (firms in group G) 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. 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	Extensive Margin	
	$\Delta \ln X_{ipd}$	$\Delta \ln N^E_{Gpd}$	$\Delta \ln N^C_{Gpd}$
	(1)	(2)	(3)
Panel 1:	Size of Export Flow		
$\Delta \ln C_i$	0.239**		
	(0.107)		
$\Delta \ln C_i \cdot (X_{ipd} > \overline{X_{pd}})$	-0.136		
	(0.152)		
$\Delta \ln(\sum_{i \in G} C_i)$			0.543***
			(0.206)
$\Delta \ln(\sum_{i \in G} C_i) \cdot (X_{ipd} > \overline{X}_{pd})$			-0.391*
			(0.228)
Size-Product-Destination FE	Yes		Yes
Observations	14,208		3,289
Panel 2:	Distance to Destination Market		
$\Delta \ln C_i$	0.294***		
	(0.077)		
$\Delta \ln C_i \cdot (dist_d > \overline{dist})$	-0.172		
	(0.152)		
$\Delta \ln(\sum_{i \in G} C_i)$		3.904	0.377**
		(17.338)	(0.151)
$\Delta \ln(\sum_{i \in G} C_i) \cdot (dist_d > \overline{dist})$		-4.210	-0.231
		(17.436)	(0.170)
Product-Destination FE	Yes	Yes	Yes
Observations	14,146	2,380	6,324

IV estimations of equation (6) and (7). The change in (log of) credit, $\Delta \ln C_i$ ($\Delta \ln(\sum_{i \in G} C_i)$), is instrumented with F_i (F_G), a dummy that takes value 1 if the firm (firms in group G) 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. 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

	Intensive Margin	Extensive Margin	
	ΔX_{ipd}	$\Delta \ln N^E_{Gpd}$	$\Delta \ln N^C_{Gpd}$
	(1)	(2)	(3)
Panel 1:	External Finance Dependence		
$\Delta \ln(C_i)$	0.211**		
	(0.083)		
$\Delta \ln(C_i) \cdot HighFinDep_p$	-0.004		
	(0.169)		
$\Delta \ln(\sum_{i \in G} C_i)$		1.859	0.645***
		(6.579)	(0.222)
$\Delta \ln(\sum_{i \in G} C_i) \cdot HighFinDep_p$		-1.842	-0.469*
		(6.615)	(0.257)
Observations	12,652	3,561	5,246
Product-Destination FE	Yes	Yes	Yes
Panel 2:	Trade Credit		
$\Delta \ln(C_i)$	0.200***		
	(0.075)		
$\Delta \ln(C_i) \cdot HighTradeCredit_p$	0.104		
	(0.190)		
$\Delta \ln(\sum_{i \in G} C_i)$		1.478	0.338***
		(6.926)	(0.124)
$\Delta \ln(\sum_{i \in G} C_i) \cdot HighTradeCredit_p$		-1.378	0.030
		(6.950)	(0.213)
Observations	14,208	3,561	5,246
Product-Destination FE	Yes	Yes	Yes
Panel 3:	Product Differentiation		
$\Delta \ln(C_i)$	0.208***		
	(0.069)		
$\Delta \ln(C_i) \cdot Homogeneous_p$	-0.116		
	(0.186)		
$\Delta \ln(\sum_{i \in G} C_i)$		0.249	0.499***
		(0.197)	(0.152)
$\Delta \ln(\sum_{i \in G} C_i) \cdot Homogeneous_p$		-0.091	-0.432**
		(0.237)	(0.181)
Observations	13,537	3,667	5,517
Product-Destination FE	Yes	Yes	Yes

IV estimation of equations (6) and (7). The change in (log of) credit, $\Delta \ln C_i$ ($\Delta \ln(\sum_{i \in G} C_i)$), is instrumented with F_i (F_G), a dummy that takes value 1 if the firm (firms in group G) 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). Definition of homogeneous products is from Rauch (1999). 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