Specialization in Bank Lending: Evidence from Exporting Firms *

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August 10, 2015

Abstract

This paper develops an empirical approach for identifying the existence of bank advantages in funding export activities of related firms. We find that bank loan portfolios are skewed towards firms exporting to a given destination. This skewness predicts the flow of new loans in specifications that saturate all bank-time and firm-time variation: firms that expand exports to a country increase debt disproportionately, and are more likely to establish a new relationship, with banks that specialize in that country. We show that bank credit supply shocks have a larger effect on exports towards the markets of specialization.

*We thank Luana Zaccaria for outstanding research assistance. We thank Luis Garicano, Asim Khwaja, Nicola Gennaioli, Rebecca Zarutskie, Johan Hombert, and participants at Bank de France, Cambridge University, CEMFI, ERWIT 2015, Financial Intermediation Research Society Conference, LBS Finance Symposium, LSE, NBER CF, NY Fed, Paris Trade Group, ICD Annual Conference in Financial Economics, SED 2015, Stanford University, Stanford University GSB, University of British Columbia Sauder School of Business, UC Berkeley, UC Berkeley HAAS School of Business, UC San Diego, University of Zurich seminars, workshops, and conferences for useful comments. All errors are our own. Please send correspondence to Daniel Paravisini (d.paravisini@lse.ac.uk), Veronica Rappoport (v.e.rappoport@lse.ac.uk), and Philipp Schnabl (schnabl@stern.nyu.edu).

1 Introduction

Are banks differentially equipped to evaluate projects in different markets or sectors of economic activity? Or is a loan from one bank as good as a loan from any other? The answer to this question is fundamental for evaluating the economic consequences of bank failures, runs, liquidity shortages, and other events that reduce a bank's supply of credit. If banks have quantitatively important capabilities in funding specific markets or economic activities, their funding will be difficult to substitute and credit shortages by a single bank may have first order effects on the real output of the market or activity in which the bank is specialized in. Answering this question is also essential for the appropriate assessment and regulation of bank competition. Traditional measures of bank competition based on the geographical density of bank branches will be misleading if lending advantages allow neighboring banks to act as monopolists in their respective activities of expertise.

In this paper we construct a novel measure of bank specialization based on the bank's portfolio of corporate loans; and develop an empirical method to relate this specialization measure to the bank's advantage in issuing new loans. We apply the methodology in the context of the funding of exporting firms in Peru, where banks may specialize in funding exports to different destination markets (countries). We use a non-parametric, data-driven approach to define bank specialization in any given country. We first characterize the distribution of the share of funding each bank allocates to exporters to a destination country. We document that this distribution is heavily right-skewed: each country has a subset of banks with an abnormally large loan portfolio exposure to its exports. The outliers are also persistent: 94% of the banks remain heavily exposed to the same country for over half of the observed sample period between 1994 and 2010. We use theses facts to define a bank to be specialized in a country if it is an outlier in the right tail of the exposure distribution of that country.

To illustrate the specialization definition consider the bank export exposures to two countries, presented in the table below. Exports to China account for 18.2% of the to-

tal Peruvian exports in 2010, but represent a much larger fraction (30.1%) of the Spanish bank Santander's associated exports. Exports to Switzerland account for 9.3% of total exports, but account for 34.3% CitiBank's associated exports. In this example Santander and Citibank are defined to be specialized in China and Switzerland, respectively. Measuring specialization as portfolio share outliers implies that each specialized bank has a relatively low exposure on the country of specialization of the others: Santander has a below average exposure to Switzerland exports (0%) and Citibank has a below average exposure to China (11.7%).

Bank Exposure to Country of Export Destination. An Example

	Country of Export Destination	
	China	Switzerland
Weight in Total Exports	0.182	0.093
Weight in bank's exporter portfolio		
Santander (Spain)	0.301	0.000
CitiBank (U.S.)	0.117	0.343

The observed patterns of specialization are consistent with the existence of bank advantages in lending across markets. In the context of the financing of exporters, a bank has an advantage if it can provide credit at a lower cost, more credit for the same borrower characteristics, or more value added services attached to the issuance of credit (letter of credit, network of contacts in the destination country, etc.) than other lenders. However, neither firm credit demand nor the value added services provided by banks are observable by the econometrician in most empirical settings, including ours. We propose a revealed preference approach to identify advantages in lending that circumvents this problem. If banks are substitutable sources of funding, the variation in a firm export activity with one country should be uncorrelated with the identity of the bank providing the funding. In the absence of special bank capabilities, a firm that expands exports to China is equally likely in expectation to increase its borrowing from the bank that is spe-

cialized in exporters to China (Santander) as from the bank that is specialized in exporters to Switzerland (CitiBank). Our empirical approach is based on testing the alternative hypothesis: that export variation to a destination market has a larger covariance with credit variation from banks specialized in that country than with non-specilized banks.

The empirical strategy takes advantage of the highly disaggregated nature of the credit and export data. Our empirical model represents exporting firms as a collection of projects (destination countries) in which banks may specialize in. We observe, for each firm a measure of the output of each project (exports to a country), for each bank a measure of specialization in that project (defined above), and for each bank-firm pair a measure of credit. The first step of our estimation strategy is to isolate the variation in credit that is specific to the firm-bank relationship. Since most exporters borrow from multiple banks, we use firm-time dummies to account for firm credit demand shocks that are common across all banks. We account for bank credit supply shocks that are common across all firms with bank-time dummies.[1] The residual in this saturated model is the firm-bank variation in credit that is our object of interest: it captures the equilibrium lending that results from the firm's credit demand that is bank-specific, and the bank's credit supply that is firm-specific. The second step in our estimation strategy is to compare the covariance between the firm-bank credit component and exports to a country for banks that are specialized in that country relative to those that are not.

Our baseline results show that when firms expand exports to a country, they increase borrowing 52% more from banks that are specialized in the country of destination than from non-specialized banks, once all firm-specific and bank-specific shocks are accounted for. We also explore the lending advantage of specialized banks in the extensive margin. We test whether the probability that a firm starts borrowing from a bank increases after the firm starts exporting to the country of specialization. We find that during the year after a firm starts exporting to a country, the firm is 6.4 times more likely to establish a new relationship with a bank that is specialized in the new export destination country

[1] These common shocks account for less that one third of the time series variation of credit in the data.

than with a non-specialized one.

We explore whether potential determinants of banks' geographical specialization — e.g. country of ownership of the bank, geographical and cultural distance from the bank's headquarters to the export market, geographical distribution of the bank subsidiary network— can account for the observed pattern of lending. We find that, even though specialization is correlated with country of ownership, banks' advantage in lending towards an export destination cannot be summarized as a home-country advantage. Our measure of specialization explains the pattern of lending, even after controlling for the physical presence of global banks in the destination market.

Existing theories that emphasize the role of financial intermediaries in producing information have long recognized that bank debt is difficult to substitute with uninformed capital (e.g., Leland and Pyle, 1977; Diamond, 1984; Ramakrishnan and Thakor, 1984; Fama, 1985; Sharpe, 1990; Diamond, 1991; Rajan, 1992; Rajan and Winton, 1995; Holmstrom and Tirole, 1997). Our results stress that different banks may have distinct advantages in different markets or economic activities, and thus funding *across* financial intermediaries is less-than-perfectly substitutable.

The extensive margin results suggest that the documented market-specific advantages are distinct from the *firm-specific* advantage conferred by proprietary information gathered through the lending process (see Bernanke, 1983; James, 1987; Hoshi et al., 1990; Petersen and Rajan, 1994; Petersen and Rajan, 1995; Berger and Udell, 1995; Degryse and Ongena, 2005; Chava and Purnanandam, 2011; Bolton et al., 2013; for surveys see Boot, 2000 and Ongena and Smith, 2000). To explore this issue further, we evaluate whether the lending advantages suffer the trade-off between relationship lending advantages and bank size theorized in Stein (2002) and documented in Berger et al. (2005). We find no evidence of such trade-off: neither the bank specialization measure nor the bank lending advantage vary systematically with bank size in the cross section or in the time series. More conclusively, we analyze banks' patterns of lending around acquisitions and find that the set countries in which the *target* bank specializes before the merger predicts the

lending advantage of the combined bank after the acquisition. The results imply that banks retain the capabilities in their markets of specialization even as they grow larger and that they inherit the specialization set of the target bank after an acquisition. The evidence indicates that source of bank advantage uncovered here is scalable and not hindered by organizational constraints.

A corollary of our findings is that it is extremely difficult to identify empirically the supply of bank credit in the presence of shocks that affect the sector of economic activity in which banks are specialized. The now standard econometric approach for identifying the lending supply channel accounts for credit demand variation with firm-time fixed effects (see, for example, Khwaja and Mian, 2008; Paravisini, 2008; Schnabl, 2012; Jimenez et al., 2014; Chodorow-Reich, 2014). This strategy relies in the assumption that changes in firm credit demand are, in expectation, equally spread across all banks lending to the firm. In the presence of bank specialization, this assumption only holds under very restrictive conditions, e.g., for shocks to bank credit supply that are either uncorrelated with sectorial demand, or that affect proportionally all the potential sectors of economic activity in which banks may specialize in.[2] We illustrate how this identification assumption can be tested with within-firm specifications that account the banks' pattern of export specialization. Using the empirical setting in Paravisini et al. (2015) we show that the source of the bank's funding shock is uncorrelated with shocks to the country of specialization, a necessary condition to disentangle econometrically credit supply from credit demand. In that setting we find that demand shocks explain a larger amount of the within-firm variation in credit than bank funding shocks, which implies that confounding the two effects can lead to severely biased results.

We exploit the same empirical setting to evaluate whether a bank's credit supply shock has a disproportionate effect on exports to the country of bank specialization. We find that it does: the same decline in bank credit supply reduces exports by 33% more to

[2]Identification is complicated further by the relatively large exposure that the balance sheet of specialized banks have to market or sector that receives the shock. This means that a pure demand shock to a sector may affect disproportionately the supply of credit by banks specialized in that sector.

countries where the bank is specialized in, relative to those that it is not. This implies that firms cannot easily substitute specialized sources of funding, and that the bank lending advantages are economically significant.

Our results have two additional implications for understanding the industrial organization of bank credit markets. First, bank specialization provides a new rationale for why firms have multiple banking relationships and why banks form syndicates. Leading theories for multi-bank relationships hinge on arguments of ex post-renegotiation (Bolton and Scharfstein, 1996), information rents by relationship lenders (Rajan, 1992), and diversification of firms' exposure to bank failures (Detragiache et al., 2000), while existing explanations for loan syndicates include risk diversification and regulatory arbitrage (Pennacchi, 1988). Multiple bank relationships and syndicates may arise naturally in a world where banks are differentially equipped to evaluate different projects of the same firm: multi-project firms demand credit from specialized banks for each project, and banks' combined expertise allows a more accurate risk assessment of complex, multi-project firms. Second, our results highlight the limits of bank diversification. Traditional banking theory argues that full diversification across sectors and projects is optimal (e.g., Diamond, 1984, Boyd and Prescott, 1986). Comparative advantages in bank lending can limit the extent to which it is optimal for banks diversify their loan portfolios.

The rest of the paper proceeds as follows. Section 2 describes the data. In section 3 we present a theoretical framework that guides our exercise, we define our measure of bank specialization, and present the methodology to empirically asses whether this measure is an indicator of an advantage in lending. The results are presented in section 4. Section 5 illustrates the importance of accounting for bank specialization when measuring credit supply shocks and their consequences. Finally, section 6 concludes.

2 Data

We use two data sets: monthly panel loan level data on credit in the domestic banking sector and customs data for Peruvian exports over the period 1994-2010.

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

We match the loan data to export data using a unique firm identifier assigned by SUNAT for tax collection purposes. The credit data are a monthly panel of the outstanding debt of every firm with each bank operating in Peru.

Table 1 shows the statistics describing the data. The unit of observation in our empirical analysis in Section 3.3 is at the bank-firm-country annual level. Each observation combines the annual average bank-firm outstanding debt with the firm's annual exports to each country of destination, expressed in US dollars (FOB). The total number of observations in the full dataset, described in Panel 1, is 378,766. The average annual firm-bank outstanding debt is US$ 2,044,488 and the average firm-destination annual export flow is US$ 2,148,237. However, as it is usual for this type of data, exports and debt are right skewed. The median debt and export flow are only US$ 259,764 and US$ 87,218, respectively.

Panel 2 in Table 1 describes the 14,267 exporting firms in our data. On average, the median firm borrows from 2 banks and exports to only 1 destination. In this dimension also the data are right skewed, the average number of banking relationships per firm is 2.42 and the number export countries is 2.65. We restrict the export destination to the main 22 markets, which represent 97% of Peruvian exports across the entire period of analysis.[3]

[3]The included countries are Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Den-

3 Framework and Methodology

This section presents a model where banks are imperfectly substitutable sources of funding and are heterogenous in their lending capabilities towards specific economic activities, which we pair in the data with advantages towards funding exports to specific destinations. This framework guides our definition of bank specialization, and the empirical methodology used to assess whether bank specialization in a country is an indicator of an advantage in lending to exporters to that destination. That is, whether our measure of specialization, based on the stock of existing loans, predicts the flow of new loans.

3.1 Theoretical Framework of Specialized Bank Lending

This section presents a simple partial equilibrium model that guides our empirical methodology and rationalizes the results in the paper. Firms are characterized by a collection of activities that require funding, and banks differ in their pattern of activity-specific lending advantages. Without explicitly defining the market structure for the firms' output nor the sources of banks' lending advantages, our goal is to present a reduced-form framework in which different sources of funding are not freely substitutable.

Each firm $i = 1, ..., I$ uses bank credit to finance a variety of activities $j \in J_i$ according to the following production function:

$$q_{ij}\left(\{L_{ib}^{j}\}_{b=1}^{B}\right) = \left[\sum_{b=1}^{B} \gamma_{jb}^{\frac{1}{\rho}} \left(L_{ib}^{j}\right)^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}} \tag{1}$$

where $b = 1, ..., B$ are the different commercial banks in the banking industry, $\rho > 0$ is the elasticity of substitution between credit from different banks, and γ_{jb} is the comparative advantage of bank b in credit specific to activity j.[4]

mark, Ecuador, France, Germany, Italy, Japan, Korea, Netherlands, Panama, Spain, Switzerland, United Kingdom, United States, and Venezuela.

[4]This CES specification generates the same credit demand function as the aggregate of a large number of firms, each discretely choosing the bank and then borrowing a given amount from the selected one, to fund activity j (see Anderson et al., 1987).

The optimal borrowing of firm i from each bank b to fund each activity j responds to the following cost-minimization problem:

$$\min_{\{L_{ib}^j\}_{j,b}} \sum_{b=1}^{B} r_b \, L_{ib} \qquad s.t. \quad q_{ji}\left(\{L_{ib}^j\}_{b=1}^{B}\right) = \overline{q}_{ji} \quad \forall j \in J_i$$

where $L_{ib} = \sum_{j \in J_i} L_{ib}^j$ is total credit with bank b, and $q_{ji}\left(\{L_{ib}^j\}_{b=1}^{B}\right)$ is defined in equation 1. Then, the optimal funding of firm i from bank b allocated to activity j is:

$$L_{ib}^j = \left(\frac{1}{r_b}\right)^{\rho} \lambda_{ij} \, q_{ji} \, \gamma_{jb}$$

$\lambda_{ij}^{1/\rho}$ is the multiplier on the output constraint, which is the marginal cost of producing q_{ij}. We use the transformation of marginal cost, λ_{ij}, to translate quantities q_{ij} into monetary values, and denote $X_{ij} \equiv \lambda_{ij} q_{ij}$.[5] Then, the overall debt of firm i with bank b can be expressed as:

$$L_{ib} = \left(\frac{1}{r_b}\right)^{\rho} \sum_{j \in J_i} X_{ji} \, \gamma_{jb} \tag{2}$$

Each bank b is characterized by the price of lending, r_b, and a vector of activity-specific capabilities $\gamma_b = [\gamma_{1b}, ..., \gamma_{Jb}]$. This parameter can be interpreted as an activity-specific monitoring advantage, an activity-specific discount on interest rate, r_b, or as a service associated with the activity. For example, in the case of exporting to a given country, it could be bank's presence in the destination market.

Notice that if all sources of credit are perfect substitutes (i.e. $\rho = \infty$), the funding of activity j in (1) is given by the overall funding of firm i allocated to activity j, without differentiating the lending institution, $q_{ij} = \sum_{b=1}^{B} L_{ib}^j$. If this is the case, firms would only borrow from the bank that offers funding at the lowest price, r_b. On the other hand, if sources of credit are not perfect substitutes (i.e. $0 < \rho < \infty$) and banks are heterogeneous,

[5] If, close to the empirical exercise in the body of the paper, firms produce homogenous goods in a competitive market and $j = 1, ..., J$ correspond to different destination markets, then the marginal costs are equalized across firms and destinations and it is equal to the international price. In that case, X_{ji} corresponds to the value of exports by firm i to destination j.

firms have multiple banking relationships. The price of credit charged by each bank influences its size, measured in overall lending (i.e. $\frac{\partial \ln \sum_i L_{ib}}{\partial \ln r_b} = -\rho < 0$), but in equilibrium there is room for multiple banks of different sizes.

This framework guides our empirical methodology. We derive from here the measure of bank's portfolio share associated to a given economic activity that we use in subsection 3.2. Our framework implies that, if banks are imperfectly substitutable sources of funding, then each bank has a larger portfolio share associated to the activity in which they have lending advantage. Moreover, we derive from this framework the rationale from our revealed preference identification strategy presented in section 3.3. If a firm increases its outcome in activity j, and banks are imperfectly substitutable sources of funding, it will increase its share of credit with the bank that has lending advantage in that activity.

More formally, consider two banks b, b' that have same productivity parameters for all activities, with the exemption of sectors j and j' for which $\gamma_{bj} = \gamma_{b'j'} > \gamma_{bj'} = \gamma_{b'j}$. The following results follow from equation 2.

Result 1. *The share of lending associated to activity j is higher for bank b than for bank b'. That is, let S_{bj} be defined as:*

$$S_{bj} \equiv \frac{\sum_{i=1}^{I} L_{ib} X_{ij}}{\sum_{k=1}^{J} \sum_{i=1}^{I} L_{ib} X_{ik}}$$

Then, $S_{bj} > S_{b'j}$.[6]

Result 2. *The elasticity of lending to outcome of activity j is higher for the bank with comparative advantage in activity j. That is, $\frac{\partial \ln L_{ib}}{\partial \ln q_{ij}} \geq 0$ and increases with γ_{jb}.*

3.2 Specialization Measure

In this section we use the definition of bank portfolio share associated to an economic activity in Result 1, to obtain a measure of specialization that is scaled by bank size. Each economic activity in the framework presented in subsection 3.1 represents a geographical market—an export destination country—in the data.

[6] The derivation of this result is in the appendix.

Let $i = 1, ..., I$ be the universe of exporting Peruvian firms and $c = 1, ..., C$ be the destination country of exports. We define S_{bct} to be bank-b borrowers' exports (weighted by their debt in bank-b) to country c, as a share of bank-b borrowers' total exports. That is:

$$S_{bct} \equiv \frac{\sum_{i=1}^{I} L_{bit} X_{ict}}{\sum_{c=1}^{C} \sum_{i=1}^{I} L_{bit} X_{ict}} \tag{3}$$

where X_{ict} are exports by firm i to destination country c in year t and L_{bit} is outstanding debt of exporting firm i with bank b in year t.

The share of bank lending associated to exports to any given destination is heavily influenced by the importance of that destination market in overall Peruvian exports. For example, since a large fraction of total Peruvian exports are destined to U.S., most banks will show a high share of exports by their borrowers to U.S. (see Figure **??** for the country composition of Peruvian exports). We want the specialization measure to capture banks' departures from the overall specialization pattern of Peruvian exports: A bank is specialized if its portfolio is skewed (relative to other banks) towards loans associated to a given country. We adopt a non-parametric approach to systematically identify the outlier banks in the distribution of $\{S_{bct}\}$ for each country-year.

To illustrate the approach, we depict with a box-and-whisker plot in Figure 1 the distribution of $\{S_{bct}\}$ across banks for each country in year 2010. To facilitate the interpretation, we plot $\{S_{bct} - \overline{S}_{ct}\}$ instead of $\{S_{bct}\}$ so that all the country distributions are centered at zero. The ends of each box denote the 25-th to 75-th percentiles of the distribution, and the size of the box is the interquartile range (IQR). The "whiskers" delimit the range between the upper and lower extreme values of the distribution, defined as the highest datum still within 1.5 IQR of the 75-th percentile and the lowest datum still within 1.5 IQR of the 25-th percentile, respectively. Then, for a given country and year, we consider a bank to be an outlier of the distribution if its observation lays outside the "whiskers." [7] The outliers

[7] This method for identifying outliers makes no assumption about the data distribution model. See Hodge and Austin (2004) for a survey on outlier detection methods. In a normally distributed sample this definition would correspond to observations above (below) the mean plus (minus) 2.7 times the standard deviation of the distribution.

are identified with dots in the plot for each country. We define a bank to specialized in a country if it is an outlier on the right tail of the $\{S_{bct}\}$ distribution. More formally:

Definition 1 (Specialization)**.** *We consider a bank-country-year observation, S_{bct}, to be an outlier, which we signal with the dummy $O(S_{bct}) = 1$, if S_{bct} is above the upper extreme value, defined by the 75-th percentile plus 1.5 interquartile ranges of the distribution of $\{S_{bct}\}$ across banks for a given country-year. We refer to an outlier bank as* ***specialized*** *in the corresponding country, during the corresponding year.*

Our measure of specialization captures bank exposure that is driven by, both, the number of firms and firm size. Consider as an example the two polar cases: a bank's portfolio exposure to a country may be abnormally large because it lends to a large number of small exporters relative to other banks, or because it provides a large fraction of the credit to a large exporter relative to other banks. Both polar cases would arise in a framework where firms are modeled as a collection of economic activities, and banks have a lending advantage towards a subset of these activities (as in the framework in subsection 3.1). It remains to be shown whether this measure of specialization, based on the existing portfolio of loans, can also predict the pattern of new credit. This is the subject of the next subsection.

3.3 Identifying Advantage in Lending

In the context of the financing of exporters, a bank has an advantage if it can provide credit at a lower cost, more credit for the same borrower characteristics, or more value added services attached to the issuance of credit (letters of credit, presence in the country of destination, etc.) than other lenders. The empirical problem resides in that the econometrician does not observe firm's project-specific demand for credit nor the value added services provided by banks.

We adopt a revealed preference approach to evaluate advantages. Under the null hypothesis that banks do not have advantages in lending—e.g. that credit from one bank

is as good as credit from any other, variation in a firm's export activity with one country should be uncorrelated with the identity of the bank providing the funding (ceteris paribus). For example, a firm that expands exports to China is equally likely in expectation to increase its borrowing from the bank that is specialized in exporters to China as from the bank that is specialized in exporters to Switzerland.

Our empirical strategy tests the alternative hypothesis: variations in firm exports to a country are correlated with credit from banks specialized in that country, as shown in section 3.1 (Result 2). We build on the recent literature that uses micro-data to account for firm credit demand shocks that are common across all banks with firm-time dummies, and for bank credit supply shocks that are common across all firms with bank-time dummies (see for example Jimenez et al., 2014). In a nutshell, we show that once *all* time-varying firm-specific and bank-specific shocks are accounted for, firms borrow more from banks that are specialized in the country they export to.

Consider the following general characterization of the lending by bank b to firm i at time t:

$$L_{bit} = L\left(L_{bt}^{S}, L_{it}^{D}, \mathcal{L}_{bit}\right) \tag{4}$$

Bank-firm outstanding credit is an equilibrium outcome at time t, determined by the overall supply of credit by the bank, L_{bt}^{S}, which varies with bank-level variables such as overall liquidity, balance-sheet position, etc.; the firm's overall demand for credit L_{it}^{D}, which varies with firm-level productivity, demand for its products, investment opportunities, etc.; and, finally, a firm-bank specific component, $\mathcal{L}_{bit}$, which corresponds to our element of interest: the component of bank-b's lending that depends on its relative advantage in markets supplied by the firm i.

The goal of our empirical strategy is to test whether the bank-firm pair component of lending varies with firm-i's export activity in markets in which bank-b specializes. In other words, we test whether the covariance between $\mathcal{L}_{bit}$ and X_{ict} (firm i's exports to destination market c) increases in $\mathcal{S}_{bct}$ (a measure of specialization of bank b on destination market c).

In the baseline specification we use specialization up to the year of the loan: for every year t, it corresponds to the fraction of years up to year $t-1$ in which bank b is an outlier in the loan distribution associated to country c:

$$\mathcal{S}_{bct-1} = \frac{1}{(t-1)-t_0} \sum_{\tau=t_0}^{t-1} O(S_{bc\tau}) \tag{5}$$

where t_0 is the first year that the bank appears in our dataset and $O(S_{bct})$ is our measure of specialization in Definition 1.

Our empirical estimation accounts for the bank-specific credit supply shocks L_{bt}^S (common in expectation across all firms) by saturating the empirical model with a full set of bank-time dummies, α''_{bt}. We account for the firm-specific credit demand shocks L_{it}^D (common in expectation across all banks) by saturating the model with a full set of firm-time dummies, α'_{it}. Then, for each country-bank-firm-year our baseline specification is:

$$\ln L_{bit} \quad = \quad \alpha_{ib}^c + \alpha'_{it} + \alpha''_{bt} + \beta_1 \ \ln X_{it}^c + \beta_2 \ \mathcal{S}_{bt-1}^c \times \ln X_{it}^c + \epsilon_{ibt}^c \tag{6}$$

Outstanding debt is a firm-bank-year value, L_{bit}—i.e. we do not observe separately the credit a bank provides to fund each exporting activity, we only observe total credit provided by the bank to the firm. However, for each firm-bank-year, there are 22 relationships like the one in (6), one for each country c in our analysis sample. To estimate the parameters of (6) we stack the observations for all countries and adjust the standard errors for clustering at the bank-country and firm level to account for the fact that L_{bit} is constant across countries for a given bank-firm-time triplet. The c superindices on exports X_{it}^c, the bank specialization measure $\mathcal{S}_{bt}^c$, the fixed-effects α_b^c and the error term ϵ_{ibt}^c indicate that they vary by country in the stacked estimation. The set of time-invariant bank-country fixed effects, α_b^c, accounts for all unobserved heterogeneity in the bank-country lending relationship, such as the distance between bank headquarters (for international banks) and the country of destination. We estimate this specification demeaned, to get rid of the

time-invariant fixed effects.

Parallel to specification (6), we also test whether the the probability that a firm starts borrowing from a bank increases after the firm starts exporting to the country of specialization. We estimate the following linear probability model:

$$\begin{aligned}(L_{bit} > 0 | L_{bit-1} = 0) \quad &= \quad \alpha^c_{ib} + \alpha'_{it} + \alpha''_{bt} + \beta_1 \left(X^c_{it-1} > 0 | X^c_{it-2} = 0\right) \\ &\quad + \beta_2 \, \mathcal{S}^c_{bt-1} \times \left(X^c_{it-1} > 0 | X^c_{it-2} = 0\right) + \epsilon^c_{ibt} \end{aligned} \tag{7}$$

where $(L_{bit} > 0 | L_{bit-1} = 0)$ is a dummy equal to 1 if the firm i borrows from bank b in year t, but not in year $t-1$; and, correspondingly, $(X^c_{it-1} > 0 | X^c_{it-2} = 0)$ is a dummy equal to 1 if the firm i exports to country c in year $t-1$, but not in year $t-2$.

Our coefficient of interest in specifications (6) and (7) is β_2. A coefficient $\beta_2 > 0$ indicates that, for a given firm, the correlation between its exports and outstanding debt is higher with banks specialized in the country of destination (equation 6), or that the probability of starting borrowing from bank increases when the firm starts exporting to its country of specialization (equation 7). This is the case if, for example, a firm needing credit to fund its export activities towards China is more likely to obtain it from banks specialized in the China than from other banks. In contrast, if all sources of credit are perfect substitutes (e.g. banks do not have comparative advantages), or if our measure of specialization is pure noise and uncorrelated with comparative advantage, then $\beta_2 = 0$.

It is important to highlight that our approach tests a joint hypothesis: that banks have advantages in lending, and that firms require credit to sustain exporting activities. If this second hypothesis is false, a change in the amount of exports does not translate into an increase in the demand for credit, which would mean that our tests would not reject the null hypothesis. In previous work using Peruvian data during the 2008 Great Recession we test the second hypothesis independently and find that, indeed, firm's exporting activity is bank-finance dependent (Paravisini et al., 2015).[8]

[8] Amiti and Weinstein (2011), Feenstra et al. (2014), and Manova (2013), among others, also find that bank credit affects the intensive margin of exports (i.e. variations in the amount of exports of exporting firms).

4 Results

In this section we characterize the patterns of bank specialization, according to the definitions in subsection 3.2. We then show, following the empirical strategy in subsection 3.3, that bank specialization at a given moment in time predicts the subsequent pattern of credit.

4.1 Patterns of Bank Specialization

We compute the shares of lending associated to each export market using outstanding debt of Peruvian firms in the 33 commercial banks operating in Peru between 1994 and 2010, and firm shipment-level export data to the 22 largest export destination markets. [9]

The values of S_{bct} defined in (3) provide information on the heterogeneity in lending shares by country across banks. In Table 2 we present descriptive statistics of S_{bct} by country, demeaned by the average share across all banks in the corresponding country, $\overline{S}_{ct}$ (the mean for each country is zero by construction). The median of $S_{bct} - \overline{S}_{ct}$ is negative for every country, indicating that the within-country distribution of $\{S_{bct}\}$ is right-skewed. This is confirmed in column 5 where we report a large and positive skewness for every country (the right skewness is also salient in Figure 1). This implies that for every destination country in the sample there are always some banks that are heavily specialized in its related exports.

Column 1 in Table 3 reports the number of countries each bank specializes in at least once in the sample period, according to Definition 1. Banks specialize in several countries during the 17-year period, with one bank (code 73) reaching a maximum of 15 countries out of a total of 22. These numbers lower considerably once we count the countries in which each bank specializes for at least 25% , 50%, or 75% of the time they appear in the sample (columns 2 to 4). Even using a stringent definition of specialization in which the bank must be an outlier in the country for at least 75% of the observed sample period in

[9] The bank panel is unbalanced because of entry, exit and M&A activity (we discuss M&A activity in more detail in subsection 4.3).

order to be considered specialized, 25 out of 31 banks in the sample are specialized in at least one country.

In summary, banks specialize in the export markets of related firms and each bank is associated with a subset of countries for which they exhibit long-lasting specialization.

4.2 Baseline Results

In this subsection we use the methodology described in subsection 3.3 to evaluate whether specialized banks have an advantage in lending towards specific export activities. We present the OLS estimates of specification 6, demeaned, in Table 4, column 1.

The coefficient on (log) exports is positive and significant, with elasticity 0.026. This coefficient captures the correlation between the firm-bank specific component of debt and the firm's average exports *to the countries in which bank b is not specialized in*.[10] The positive coefficient implies that, when firms expand exports to a country, they borrow more on average from all banks, regardless of whether the destination country is outside the bank's markets of expertise.

Our coefficient of interest on the interaction between log exports and the specialization measure is 0.014 and significant at the 5% level. This indicates that the covariance between credit and exports is significantly larger when the bank issuing the debt is specialized in the destination country. The coefficient implies that the covariance is 52% higher for a bank that has been specialized in the country for the full sample period up to t ($\mathcal{S}^c_{bt-1}$=1) relative to one that has not been specialized in the country at all ($\mathcal{S}^c_{bt-1}$=0).

Table 4, column 2, presents the OLS estimates of the entry margin specification in (7). The entry margin regression focuses on the sample of potential bank-firm relationships: all the bank-firm pairs that do not have a positive outstanding balance in any given year (thus, the large sample size and the low probability of a new relationship). The coefficient estimates indicate that the probability of starting a banking relationship with a non-

[10]Note that there is independent bank-firm variation in exports —variation that is not captured by the firm-time dummies— because not all banks specialize in the same countries.

specialized bank ($\mathcal{S}^c_{bt-1}$=0) after exporting to a new destination is 0.06%, and increases increases 6.4 times (to 0.38%) for a bank that has been specialized in that destination for the full sample period up to t ($\mathcal{S}^c_{bt-1}$=1).

These results are consistent with banks having an advantage in funding the export activities towards the countries in which the bank specializes. In this context, an advantage in lending implies that firms fund export expansions to country c with a marginal dollar obtained from a bank specialized in country c. The coefficient captures an equilibrium correlation that may be originated by demand shocks, supply shocks, or both. Under the demand interpretation, exporting to country c becomes more profitable and firms seek additional credit from the specialized banks. In the supply interpretation, banks that expand credit supply allocate the marginal dollar into the sector they are specialized in. Thus, these estimates are obtained from variation induced by generic shocks to equilibrium credit.

Although the intensive margin lending advantage documented through specification 6 may be driven by firm-specific information gained through prior interaction between the bank and the firm, the extensive margin lending advantage uncovered through specification 7 may not. First time exporters to a destination are drawn to banks that specialized in that destination even if the firm and the bank have never interacted before. Taken together, the results in Table 4 point towards bank specialization reflecting market-specific, as opposed to firm-specific, advantages in bank lending. We revisit this distinction in the next subsection, where we explore the relationship between lending advantages and bank size.

4.3 Specialization and Bank Size

In this section we characterize the pattern of specialization in the cross-section of bank size and, over time, as banks increase their overall amount of lending. The exercise is motivated by the theoretical framework in Stein (2002), which suggests there is a trade-off between bank size and the firm-specific advantage generated through relationship

lending. This lending advantage is understood as firm-specific information, difficult to communicate across hierarchical layers of the organization (*soft* information). In contrast, if the source of the lending advantage is scalable —as is assumed in the model presented in section 3.1— not only will the advantage persist for large banks, but the banks with larger advantages will be larger. Thus, the relationship between comparative advantage and bank size in our context can tell us something about the nature of the source of comparative advantage.

Table 5, columns 1 and 2, show the correlation between our measure of specialization, defined in 5, and bank size, measured by total (real) lending. Since foreign owned banks are much larger than implied by their lending in Peru, we also include the dummy $Foreign_{bt}$ to capture this size difference. Larger and foreign owned banks are not more likely, in the cross section, to be specialized in export markets (column 1).[11] For a given bank over time (column 2), the number of countries banks specialize in does not grow with size, but banks do increase their set of specialization after being acquired by a foreign bank.

We also test whether the lending patterns described in the baseline regressions in Table 4 are similar in the cross section of bank size and foreign ownership status. We test this hypothesis by estimating specifications 6 augmented with interactions of the right-hand side variables and $Foreign_{bt}$ and $SmallBank_b$, a dummy equal to 1 if b is not one of the ten largest institutions measured in total loans over the full sample period.[12] The results are reported in Table 5, columns 3 and 4. The coefficient estimates on exports interacted with specialization are similar to that in the baseline specification in Table 4. This implies that the ten largest banks in Peru have a significant comparative advantage in lending to the countries in which they specialize in. The coefficient of the interaction with $SmallBank_b$

[11] This result validates our measure of specialization. A potential concern is that the portfolio of small banks may be more sensitive to new lending or changes in export activities of related firms, as their turnover is mechanically faster. Moreover, having a small number of clients, the portfolio shares can exhibit large departures from the system's average. The lack of correlation between size and specialization is, therefore, reassuring.

[12] Since not all banks appear in all years, we rank the banks according to their average inflation-adjusted amount of total loans outstanding during the years they appear in the sample to create this variable.

is negative but statistically insignificant (column 3). Although the point estimate is noisily estimated, its magnitude suggests that smaller banks may have small lending advantages or none at all. Similarly, the lending advantage of foreign and domestic banks are not found to be significantly different from each other (column 4).

To analyze whether the lending patterns described in the baseline regressions in Table 4 are preserved, for the same bank, after they expand in size, we evaluate the relationship between lending and exports around mergers and acquisitions. We modify the data and specification 6 to perform event studies around the years were bank mergers take place. Eight-year interval subsamples around the time of the merger, four before and four after the event, are drawn from the original data and stacked to perform a single estimation. We use as an indicator of bank specialization the outlier variable in definition 1, $\mathcal{S}_b^c = O(S_{bct})$, computed the year before the merger. In one specification (column 3), we combine the merging entities into a single one before the merger, and we use the maximum of the outlier indicators of the two banks as a measure of their combined specialization (e.g. if, before the merger, bank 1 was specialized in country A and bank 2 was specialized in country B, then the combined entity is considered to be specialized in A and B before the merger). To analyze transmission of expertise within the merged bank, we also test wether the specialization set of the *target* bank (i.e., the smallest of the two institutions participating in the merger) predicts the lending pattern of the merged bank after the acquisition (column 4).

We first replicate our baseline estimation in (6) without the merger interaction terms to corroborate that the point estimates are robust to the change in sample and specification (Table 6, columns 1 and 2). The coefficients on the term $\mathcal{S}_b^c \times \ln(X_{it}^c)$ are positive and significant, similar in magnitude to those in our baseline result in Table 4. However, the relationship between exports and lending is smaller (0.011 vs. 0.026 in the baseline regression). It implies that in this subsample the correlation between exports and debt of specialized banks is more than twice the correlation with debt of non-specialized banks.

In columns 3 and 4, these regressions are augmented with the interaction of $Merger_{bt}$,

a dummy equal to 1 during the 4 years after the event for the merging entity. We also augment the bank-time, firm-time, and bank-country sets of dummies with an event dummy interaction (e.g. there is a separate bank-time dummy for every merger event). The coefficient on the triple interaction with the Merger indicator, $\mathcal{S}_b^c \times \ln(X_{it}^c) \times Merger_{bt}$, measures whether the link between the specialization and lending changes after the merger. The point estimate in column 3 is positive but statistically significant only at the 10% level. More decisively, column 4 shows that lending by the merged institution is characterized by the specialization patterns of the *target* bank before the merger. That is, the merged entity inherits (and even deepens) the specialization set of the *target* bank.

These results imply that banks retain their capabilities in the markets of specialization even as they grow or merge into larger institutions. The source of lending advantage analyzed here is thus distinct from that derived from firm-specific information (stressed in Stein, 2002) and it is not hindered by organizational constraints.

4.4 Geographical Advantages of Global Banks

Market expertise may also be global, derived from the natural advantages provided by the superior information that multinational banks may have on their home countries, its neighbors, and the countries where they have established subsidiary networks. In this subsection we explore whether bank specialization patterns and advantages in export markets are related to the country of ownership of global banks or the country where their subsidiaries are located.

We first evaluate the correlation between our measure of bank specialization in a country and variables that capture the geographical advantages conferred by the ownership country and subsidiary network. Table 7, column 1, shows the cross-sectional correlation between the bank-country specialization index and: 1) $CountryOwnership_{bc}$, a dummy equal to 1 if bank b's headquarters are located in country c, 2) $CountrySubsidiary_{bc}$, a dummy equal to 1 if bank b has a subsidiary in country c in 2004,[13] 3) $CommonLanguage_{bc}$,

[13]The data used to obtain the subsidiary network, BankScope, does not have data from before 2004.

a dummy equal to 1 if the language in bank b's headquarters coincides with that in country c, and 4) $DistanceToHeadquarters_{bc}$ between the country of ownership and the export destination c.[14] We use for this cross sectional analysis the measure of specialization in Definition 1, $O(S_{bc\tau})$, averaged during the entire life of the bank.[15] We find that indeed, there is a connection between the bank's country of ownership and the set of specialization. Banks are more likely to specialize in the country of the headquarters or in countries with the same language.

We then explore whether bank's country of ownership is a sufficient statistic of the market-specific lending advantages found in our baseline regressions in Table 4. If lending advantages were exclusively driven by the location and network of the headquarters, including the above variables in our baseline revealed preference regression will make the specialization measure redundant. We explore this possibility by expanding the baseline regression in (6) with the four indicators above, interacted with exports (i.e., $CountryOwnership_b^c \times \ln(X_{it}^c)$, $CountrySubsidiary_b^c \times \ln(X_{it}^c)$, $CommonLanguage_b^c \times \ln(X_{it}^c)$, $DistanceToHeadquarters_b^c \times \ln(X_{it}^c)$). Results are presented in Table 7, columns 2 and 3. None of these interaction terms are statistically significant, and their inclusion in the regression does not change the magnitude or the significance of the interaction of exports and specialization.

We conclude that, even though our specialization measure is correlated with the bank's country of ownership, banks' advantage in lending towards an export destination cannot be summarized as a home-country advantage.

The facts that banks' lending advantages are persistent over time, transmitted through mergers and acquisitions, and are independent of the bank's global presence are suggestive of advantages derived from expertise. As emphasized in the literature of relation-

[14] We obtain these bilateral measures from Mayer and Zignago (2011).

[15] That is, $\mathcal{S}_{bc}$, as defined in equation (5), up to t_F, the last year the bank appears in our dataset:

$$\mathcal{S}_{bc} = \frac{1}{t_F - t_0} \sum_{\tau=t_0}^{t_F} O(S_{bc\tau})$$

ship lending (see Stein, 2002), banks *learn* from monitoring and evaluating the economic performance of their clients. The main novelty of our result is that, in contrast to the assumptions behind the relationship lending literature, the advantage conferred by this knowledge has spillovers outside the boundaries of the firm and affects all firms sharing the same economic activity.

5 Specialization and Credit Supply

In this final section we use the empirical tools developed in the paper to revisit two issues raised in the introduction. First, we show how the presence of market specialization in bank lending imposes additional challenges for the identification of bank credit supply shocks with the standard within-firm estimators used in the lending channel literature (see Khwaja and Mian, 2008; Paravisini, 2008; Schnabl, 2012; Jimenez et al., 2014; Chodorow-Reich, 2014). And second, we show that when banks have lending advantages and their debt is difficult to substitute, declines in the supply of credit by a bank can have a disproportionate effect on real economic activity in the bank's market or sector of specialization. To explore these two issues we take advantage of the overlap in data and analysis period with Paravisini et al. (2015) (hereafter, PRSW) and we reassess the key empirical findings in that paper under the lens of a specialized banking sector.

5.1 Within-Firm Identification of Credit Supply Shocks

PRSW identifies the supply lending channel using, as a source of variation, changes in the funding of Peruvian banks during the 2008 financial crisis. The supply of credit by banks with a high share of foreign funding drops substantially in mid 2008, when international portfolio capital inflows to Peru decreased sharply. The identification of this credit supply shock uses the now standard strategy that absorbs demand for credit with firm-time fixed effects. This method *assumes* that a change in firm credit demand is, in expectation, equally spread across all banks lending to the firm and, thus, absorbed by the firm-time

dummies. The goal of this subsection is twofold. First, to illustrate how, in the presence of bank specialization, this identification assumption only holds when the shock driving variations in credit supply is uncorrelated with shocks affecting the bank's market of expertise. And second, to assess the potential magnitude of the bias that may result when demand and supply variation are confounded in the within-firm estimation.

We estimate the within-firm estimator, which compares the change in the amount of lending by banks exposed to a funding shock to the *same firm*, acknowledging the potential confounding effect introduced by the bank's pattern of specialization. The funding shock is generated by the sudden stop of international portfolio capital inflows to Peru in mid 2008. Banks with a large share of foreign debt before the capital flow reversals were adversely affected by the shock. For simplicity we use a dichotomic classification of banks into *exposed* and *not-exposed*, where exposed banks are those with more than 10% of their assets funded with foreign liabilities in 2006.[16]

We estimate the following within-firm empirical model:

$$\ln(L_{ibt}) = \alpha_{ib} + \alpha_{it} + \beta \cdot Exposed_b \times Post_t + \nu_{ibt} \tag{8}$$

L_{ibt} is the 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, the approximate date of the portfolio flow reversal. $Exposed_b$ is a dummy equal to 1 if the bank has a share of foreign debt above 10% in 2006, and $Post_t$ is a dummy equal to one when $t = Post$. The regression includes firm-bank fixed effect, α_{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, α_{it}, that control for the firm-specific evolution in overall credit demand during the period under analysis. The coefficient β measures how lending by exposed and not-exposed banks changed before and after the capital flow reversals, and it is interpreted as the effect of the capital flow reversals on the supply of

[16]The threshold is the average exposure taken across the 13 commercial banks in 2006. The entire sample of 41 banks also includes 28 S&Ls at year-end 2006 with minimal exposure.

credit. The estimated coefficient is presented in Table 8, column 1 (this is an exact replication of the within-firm estimates in PRSW). The point estimate suggests that the supply of credit by exposed banks dropped by 16.8% relative to not-exposed banks after the capital flow reversals.

We augment specification 8 with the variable $(C_i^x \in Set(\mathcal{S}_b > 0)) \times Post_t$. The dummy $(C_i^x \in Set(\mathcal{S}_b > 0))$ is equal to one if at least one country supplied by firm i, C_i^x, belongs to the set of specialization of bank b—i.e., countries for which $\mathcal{S}_b$ defined in (5) is positive in the Pre period—. The coefficient on this additional term measures the change in the equilibrium amount of credit to firms that export to the country of bank specialization, relative to the change in credit to firms that do not. The estimated coefficients of the augmented specification are shown in Table 8, column 2. The coefficient on the additional term is -0.222. It most likely has a demand interpretation: the global demand for peruvian exports declined during 2008, and firms reduced demand of credit from those banks specialized in their exporting activities. The magnitude of the coefficient indicates that the demand for export related credit dropped by 22.2% during the sample period.

The additional variable $(C_i^x \in Set(\mathcal{S}_b > 0))$ recovers bank-specific credit demand shocks that *are not* accounted for by the firm-time dummies in specification 8. This variation in credit demand, driven by the reduction in firms' export activities, explains a large fraction of the decline in equilibrium credit during the capital flow reversal episode studied in this exercise. The estimated coefficient on $Exposed_b$ is smaller, but not significantly so, when the specification is augmented with the specialization variable (column 2 versus column 1). This implies that, in this application, the foreign funding shock affecting Peruvian banks was virtually uncorrelated with confounding effects related to the banks' export market of expertise. This is a necessary condition for econometrically disentangling credit supply from credit demand shocks in this context: the source of credit supply variation cannot simultaneously impact the demand for credit driven by innovations in the banks' markets of expertise.

The signs and magnitudes of the two effects are informative of the potential bias that

may result if the source of variation simultaneously affected the bank and its market of expertise. Both estimates have the same sign, indicating that, in this setting, confounding demand and supply would lead to an overestimation of the credit supply shock. The magnitude of the potential bias is large. Interpreting the entire within-firm variation in credit as supply driven would lead to overestimate the size of supply shock by a factor of 2.4 —i.e, $(0.222 + 0.157)/0.157$.

5.2 Effect of a Bank Funding Shocks on Exports

PRSW use the credit supply shock described in the previous subsection to show that, after controlling for variations in export demand using country of destination-product-times dummies, a decline in bank credit supply leads to a decline in exports. In this subsection we augment that analysis to assess whether a bank credit supply shock has a larger impact on exports towards its country of specialization.

In the baseline reduced-form regression, taken from PRSW, we compare exports by firms with different shares of credit received from *exposed* banks:

$$\ln X_{ipct} = \alpha_{ipc} + \alpha_{pct} + \beta \sum_b \omega_{ib} Exposed_b \times Post_t + \epsilon_{ipct} \tag{9}$$

X_{ipct} is the (volume) of exports of product p by firm i to country c during the intervals $t = \{Pre, Post\}$, where the Pre and $Post$ periods correspond to the 12 months before and after July 2008, and $\omega_{ib} \equiv L_{ib} / \sum_b L_{ib}$ is the share of firm-i's credit from bank-b in the Pre period. As in the previous subsection, $Exposed_b$ is a dummy equal to 1 if the bank has a share of foreign debt above 10% in 2006, and $Post_t$ is a dummy equal to one when $t = Post$. Then, $\sum_b \omega_{bi} Exposed_b$ is the share of credit received from exposed banks. The regression includes firm-product-country fixed effects, α_{ipc}, which control for all (time-invariant) unobserved heterogeneity across firms in exporting that product to that destination. It also includes a full set of country-product-time dummies, α_{pct}, that account for non-credit determinants of exports. In particular, these dummies account for demand

shocks originated in narrowly defined export markets.[17].

Column 3 in Table 8 shows the results of estimation 9 (in first differences). Exports by firms borrowing exclusively from exposed banks are, on average, 19% lower than those by firms borrowing from not-exposed banks. Because of the country-product-time dummies, α_{pct}, this coefficient has a supply interpretation: firm exposed to a credit supply shock through their lenders reduce their volume of exports.

To consider the heterogeneous effect of the credit supply shock across markets of bank specialization we split the firm exposure measure $\sum_b \omega_{ib} Exposed_b$ into two components depending on whether the exposed bank b is specialized in the country of export destination c or not. The two resulting exposure measures, $\sum_b \omega_{ib} Exposed_b(\mathcal{S}_{bc} > 0)$ and $\sum_b \omega_{ib} Exposed_b(\mathcal{S}_{bc} = 0)$, vary at the firm-country level. The estimated coefficients on the two measures are presented in Table 8, column 4. If the exposed bank is not specialized in the destination country of the firm's exports ($\mathcal{S}_{bc} = 0$), exports by related firms drop by 16% in response to the credit supply chock. The export decline is 33% larger if the exposed bank specializes in the country of destination ($\mathcal{S}_{bc} > 0$).

These results imply that banks' expertise in export markets indeed makes their debt difficult to substitute, even by other lenders. A decline in the supply of credit by a specialized bank has a larger impact on firm exports to the country where the lender specializes in than in any other country. Combined with the results in the previous section of the paper, this implies that there are economically significant differences in bank advantages across export markets.

6 Conclusions

In this paper we document novel patterns of specialization in bank lending. Using matched credit-export data for all firms in Peru between 1994 and 2010, we show that the share of funding each bank allocates to exporters towards a destination country is heavily right

[17]Products are defined according to the 4-digit categories of the Harmonized System. Then, product-country-time dummies account, for example, for the demand for cotton T-shirts from Germany

skewed. We define a bank to specialized in a country if it is an outlier in the right tail of the exposure distribution of that country. Then, we adopt a revealed preference approach to demonstrate that bank specialization in a country is related to an advantage in providing new funding for export activities towards that country. We show, in specifications that saturate all firm-time and bank-time variation, that firms that expand exports to a destination market tend to expand borrowing disproportionately more from banks specialized in that destination market. And that firms that start exporting to a new destination are more likely to start borrowing from a bank specialized in the new market.

Our results are suggestive of banks acquiring expertise in the activities of their related firms. By learning from monitoring and evaluating the economic performance of their clients, banks gain an advantage in providing credit to other firms operating in the same market. This advantage is maintained as the bank grows in size, is transmitted through mergers and acquisitions, but it is not found to be related to the direct investment in subsidiaries in the export markets.

The findings in this paper have important implications for the identification and assessment of credit supply chocks. First, we show that a bank's credit supply shock has a disproportionate effect on the activities in which it specializes. This implies that specialized bank credit cannot be freely substitutable with unspecialized sources of finance, and that the identified lending advantage is economically significant.

And second, we illustrate the difficulty of disentangling demand from supply of credit in the presence of sectorial or aggregate shocks that affect the activity in which banks are specialized. The results in this paper call for caution when applying the empirical strategy, now standard in identifying the lending supply channel, of absorbing the demand for credit with firm-time fixed effects. This methodology relies on firm credit demand to be, in expectation, equally spread across all banks lending to the firm. In other words, this methodology relies on banks being perfect substitutable sources of funding for firms with whom they already have a credit relationship. Our results suggest that this assumption may not always hold.

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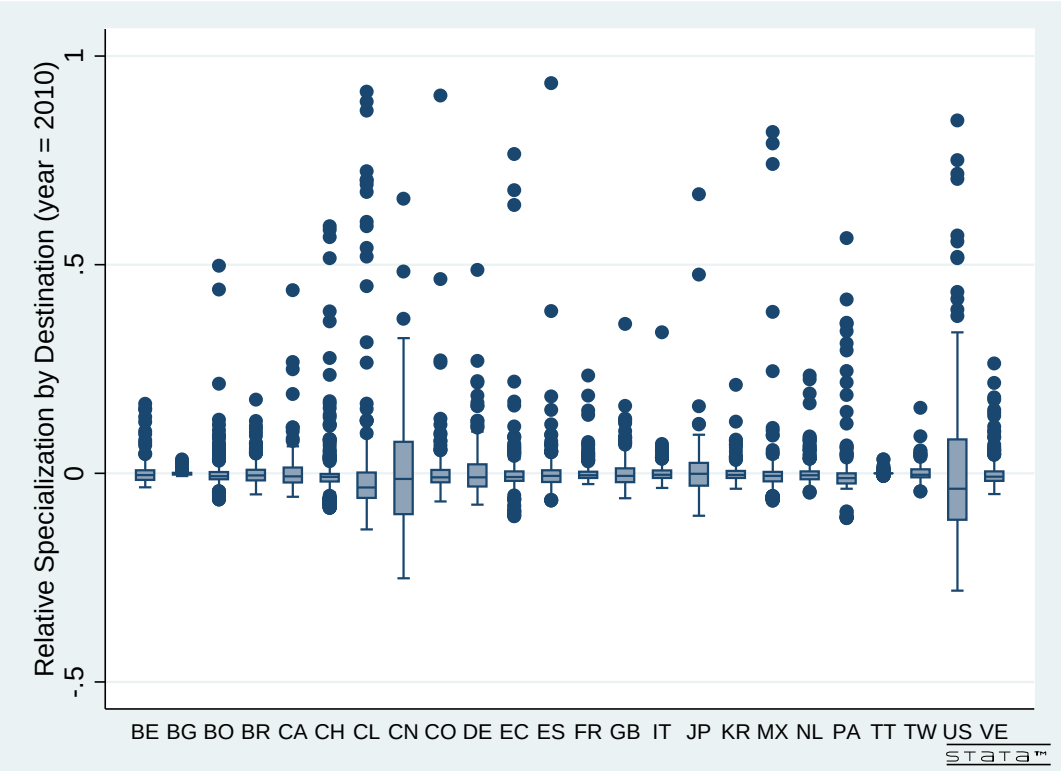
Figure 1: Distribution of Bank Lending Shares by Country



Note: The boxes encompass the interquartile range of the distribution of S_{bct} (defined in equation 3) for each country c, in year 2010. The limits of the lines encompass 4 times the interquartile rage.

Table 1: Descriptive Statistics

	Mean (1)	S.D (2)	Min (3)	Median (4)	Max (5)
Panel 1: the unit of observation is firm-bank-country-time					
Outstanding Debt (US$ '000)	2,044	6,804	0	260	235,081
Exports (US$ '000)	2,148	19,821	0	87	1,470,300
Panel 2: the unit of observation is firm-time					
Number banks per firm	2.43	1.95	1	2	19
Number destinations per firm	2.65	2.84	1	1	22

Note: The statistics in Panel 1 describe the full firm-bank-country-time panel used in Section **??**, which has 378,766 observations. Panel 2 describes the firm-time panel, which has 45,762 observations. There are 14,267 firms in the dataset.

Table 2: Distribution of Bank Lending Shares by Country

	$S_{bct} - \overline{S}_{ct}$				
	Min (1)	Median (2)	Max (3)	S.D (4)	Skewness (5)
BE	-0.0334	-0.0042	0.1663	0.0267	3.17
BG	-0.0067	-0.0010	0.0331	0.0059	2.38
BO	-0.0629	-0.0069	0.4974	0.0474	6.74
BR	-0.0504	-0.0050	0.1765	0.0281	2.02
CA	-0.0561	-0.0072	0.4388	0.0444	4.69
CH	-0.0827	-0.0084	0.5919	0.0842	4.65
CL	-0.1344	-0.0340	0.9145	0.1550	3.98
CN	-0.2515	-0.0137	0.6579	0.1211	1.00
CO	-0.0675	-0.0096	0.9051	0.0674	9.21
DE	-0.0752	-0.0096	0.4874	0.0564	3.19
EC	-0.1030	-0.0089	0.7649	0.0765	7.41
ES	-0.0652	-0.0062	0.9348	0.0643	10.62
FR	-0.0257	-0.0046	0.2343	0.0257	5.12
GB	-0.0598	-0.0063	0.3577	0.0400	3.04
IT	-0.0351	-0.0034	0.3379	0.0255	7.70
JP	-0.1017	-0.0010	0.6686	0.0619	5.45
KR	-0.0371	-0.0038	0.2119	0.0227	3.79
MX	-0.0659	-0.0061	0.8179	0.0856	7.70
NL	-0.0467	-0.0048	0.2343	0.0316	4.04
PA	-0.1077	-0.0115	0.5636	0.0680	4.72
TT	-0.0063	-0.0001	0.0332	0.0036	5.57
TW	-0.0435	-0.0033	0.1566	0.0190	2.34
US	-0.2812	-0.0372	0.8457	0.1721	1.65
VE	-0.0496	-0.0080	0.2630	0.0363	3.60
Overall	-0.2812	-0.0050	0.9348	0.0708	5.48

Note: The statistics describe the distribution of the bank-country-time share S_{bct} (defined in equation 3) demeaned by the banking system's average $\overline{S}_{ct}$.

Table 3: Patterns of Bank Specialization

	Number of countries in which the bank is an outlier for at least X% of the years in the sample			
	X = 0% (1)	X = 25% (2)	X = 50% (3)	X = 75% (4)
Bank Code				
1	7	4	2	1
2	7	3	2	2
4	6	2	2	1
6	7	3	2	1
7	5	3	2	2
9	4	2	2	1
22	8	2	1	0
25	5	3	2	2
26	4	2	1	1
31	5	3	2	1
36	5	4	1	1
52	11	3	1	0
54	5	2	2	1
55	7	4	2	1
61	13	7	2	1
68	3	2	0	0
72	13	5	3	1
73	15	7	2	1
77	5	3	2	1
78	3	3	1	1
80	3	3	0	0
81	4	3	2	1
82	5	3	2	1
120	9	4	2	0
121	11	4	1	1
122	1	1	1	1
123	12	3	2	1
124	6	3	1	0
125	9	3	2	2
126	6	3	1	1
127	5	3	3	1
130	10	6	3	1
140	4	4	1	1

Note: A bank b an outlier if S_{bct} is above the Upper Extreme Value, defined by the 75-th percentile plus 1.5 interquartile ranges of the distribution of $\{S_{bct}\}$ across banks for a given country-year (Definition 1).

Table 4: Baseline Results

Dep. Variable	$\ln(L_{ibt})$ Intensive Margin	$(L_{ibt} > 0 \mid L_{ibt-1} = 0)$ Extensive Margin
	(1)	(2)
$\mathcal{S}^c_{bt-1}$	0.03854*	-0.00022***
	(0.02190)	(0.00003)
$\ln(X^c_{it})$	0.02606***	
	(0.00500)	
$\mathcal{S}^c_{bt-1} \times \ln(X^c_{it})$	0.01376**	
	(0.00605)	
$(X^c_{it-1} > 0 \mid X^c_{it-2} = 0)$		0.00060***
		(0.00006)
$\mathcal{S}^c_{bt-1} \times (X^c_{it-1} > 0 \mid X^c_{it-2} = 0)$		0.00386***
		(0.00065)
Bank-Country FE	Yes	No
Bank-year FE	Yes	Yes
Firm-year FE	Yes	Yes
Bank-country-year FE	No	Yes
Observations	366,696	144,313,112
R^2adj	0.31026	0.28018

Note: Column 1 reports the *intensive-margin* results of specification 6, demeaned. Column 2 reports the *extensive-margin* results of specification 7. $\mathcal{S}^c_b$, defined in (5) is based on $O(S_{bct})$, is a dummy equal to 1 if bank b is an outlier in the corresponding country-year distribution, according to Definition 1. Standard errors are two-way clustered at the bank and firm levels. ***p< 0.01, **p $<$ 0.05, and *p $<$ 0.1.

Table 5: Specialization and Bank Size

Dep. Variable	$\mathcal{S}_{bct}$		$\ln(L_{ibt})$	
	between	within		
	(1)	(2)	(3)	(4)
$\ln(Size_{bt})$	-0.0064	0.0041		
	(0.0057)	(0.0040)		
$Foreign_{bt}$	-0.0212**	0.0165***		
	(0.0098)	(0.0017)		
$\ln(X^c_{it})$			0.03254***	0.03521***
			(0.00608)	(0.00449)
$\mathcal{S}^c_{bt-1}$			0.02550	0.01669
			(0.02512)	(0.02524)
$\mathcal{S}^c_{bt-1} \times \ln(X^c_{it})$			0.01365**	0.01255*
			(0.00638)	(0.00637)
$\ln(X^c_{it}) \times SmallBank_b$			-0.02634*	
			(0.01485)	
$\mathcal{S}^c_{bt-1} \times SmallBank_b$			0.05568	
			(0.05901)	
$\mathcal{S}^c_{bt-1} \times \ln(X^c_{it}) \times SmallBank_b$			-0.01566	
			(0.03011)	
$\ln(X^c_{it}) \times Foreign_{bt}$				-0.04213***
				(0.00930)
$\mathcal{S}^c_{bt-1} \times Foreign_{bt}$				0.06439*
				(0.03543)
$\mathcal{S}^c_{bt-1} \times \ln(X^c_{it}) \times Foreign_{bt}$				-0.00995
				(0.01723)
Bank FE	No	Yes	–	–
Country FE	Yes	Yes	–	–
Year FE	Yes	Yes	–	–
Bank-year FE	–	–	Yes	Yes
Firm-year FE	–	–	Yes	Yes
Country-Bank FE	–	–	Yes	Yes
Observations	7,560	7,560	366,696	366,696
R-squared	0.4892	0.5072	0.31033	0.31042

Note: In columns 1 and 2 the dependent variable is $\mathcal{S}^c_b$, defined in (5). $Size_{bt}$ is total lending of bank b at time t and $Foreign_{bt}$ is a dummy equal to 1 if the bank if foreign owned. In column 3, results of specification 6 (demeaned) are augmented with an interaction $SmallBank_b$, a dummy equal to 1 for banks outside the top 10, measured in average total (real) lending over the entire sample. In column 4, the interacting term is the time-varying dummy $Foreign_{bt}$. Standard errors are two-way clustered at the bank and firm levels. ***p< 0.01, **p $<$ 0.05, and *p $<$ 0.1.

Table 6: Persistence of Specialization after a Merger

Dep. Variable	$\ln(L_{ibt})$			
	(1)	(2)	(3)	(4)
$\ln(X^c_{it})$	0.01145***	0.01145***	0.01370***	0.01371***
	(0.00319)	(0.00319)	(0.00334)	(0.00334)
$\mathcal{S}^c_{bPreMerger} \times \ln(X^c_{it})$	0.01386***	0.01692**	0.01150**	0.01552**
	(0.00382)	(0.00706)	(0.00419)	(0.00753)
$\mathcal{S}^c_{bPreM} \times \ln(X^c_{it}) \times Target_b$		-0.00678		-0.00833
		(0.01147)		(0.01183)
$Merger_{bt}$			-0.04516*	-0.04524*
			(0.02269)	(0.02276)
$\ln(X^c_{it}) \times Merger_{bt}$			-0.02387***	-0.02391***
			(0.00853)	(0.00852)
$\mathcal{S}^c_{bPreM} \times Merger_{bt}$			0.04508***	0.03777**
			(0.01463)	(0.01707)
$\mathcal{S}^c_{bPreM} \times \ln(X^c_{it}) \times Merger_{bt}$			0.02264*	0.01536
			(0.01324)	(0.01338)
$\ln(X^c_{it}) \times Merger_{bt} \times Target_b$				0.08553***
				(0.02381)
$\mathcal{S}^c_{bPreM} \times \ln(X^c_{it}) \times Merger_{bt} \times Target_b$				0.03654**
				(0.01694)
Bank-Merger-year FE	Yes	Yes	Yes	Yes
Firm-Merger-year FE	Yes	Yes	Yes	Yes
Country-bank-Merger FE	Yes	Yes	Yes	Yes
Observations	586,097	586,097	586,097	586,097
R-squared	0.28805	0.28805	0.28809	0.28809

Note: Results of specification 6 (demeaned) with data rearranged around event time (Merger). The index of bank-country specialization is computed the year before the merger for both banks participating in the Merger. Columns 1 replicates specification 6. Column 3 adds the interaction term $Merger_{bt}$, a post-merger dummy. Similarly, Column 2 replicates specification 6 with the interaction term $Target_b$, a dummy that signals the target bank (as opposed to the acquirer), and column 4 adds the interaction term $Merger_{bt}$. Standard errors are two-way clustered at the bank and firm levels. ***p$<$ 0.01, **p $<$ 0.05, and *p $<$ 0.1.

Table 7: Specialization and Global Banks

Dep. Variable	$\mathcal{S}_{bc}$	$\ln(L_{ibt})$	
	(1)	(2)	(3)
$CountryOwnership_{bc}$	0.0946***		
	(0.0181)		
$DistanceToHeadquarters_{bc}$	0.0052*		
	(0.0030)		
$CommonLanguage_{bc}$	0.0272***		
	(0.0089)		
$CountrySubsidiary_{bc}$	-0.0015		
	(0.0081)		
$\ln(X_{it}^c)$		0.02658***	0.03841
		(0.00475)	(0.05184)
$\mathcal{S}_{bt-1}^c$		0.03865*	0.03618
		(0.02183)	(0.02184)
$\mathcal{S}_{bt-1}^c \times \ln(X_{it}^c)$		0.01383**	0.01717*
		(0.00606)	(0.00897)
$CountryOwnership_b^c \times \ln(X_{it}^c)$		-0.01967	-0.03045
		(0.02270)	(0.02300)
$ln(DistancetoHeadquarters_b^c) \times \ln(X_{it}^c)$			-0.00226
			(0.00571)
$CommonLanguage_b^c \times \ln(X_{it}^c)$			0.01030
			(0.00707)
$CountrySubsidiary_b^c \times \ln(X_{it}^c)$			0.01469
			(0.00965)
Bank FE	Yes	–	–
Country FE	Yes	–	–
Year FE	Yes	–	–
Firm-year FE	–	Yes	Yes
Bank-year FE	–	Yes	Yes
Country-Bank FE	–	Yes	Yes
Observations	7,560	366,696	366,696
R^2adj	0.5090	0.31026	0.31030

Note: In column 1 the dependent variable is $\mathcal{S}_b^c$, defined in (5). Columns 3 and 4 shows the results of specification 6 (demeaned). $CountryOwnership_{bc}$ is a dummy equal to 1 if the destination country of the export flow coincides with the country of ownership of the bank. Similarly $CountrySubsidiary_{bc}$ is equal to 1 if the bank has a subsidiary in the destination country of the export flow. The variables distance and common language refer to the connection between the bank's country of ownership and the export destination. Standard errors are two-way clustered at the bank and firm levels. ***p$<$ 0.01, **p $<$ 0.05, and *p $<$ 0.1.

Table 8: Credit Supply Shocks

	ΔL_{ib}		$\Delta \ln X_{ic}$	
	(1)	(2)	(3)	(4)
$Exposed_b$	-0.168***	-0.157***		
	(0.046)	(0.049)		
$(C_i^x \in Set(\mathcal{S}_b > 0))$		-0.222***		
		(0.083)		
$\sum_b \omega_{ib}\ Exposed_b$			-0.193***	
			(0.063)	
$\sum_b \omega_{ib}\ Exposed_b\ (\mathcal{S}_{bc} > 0)$				-0.165***
				(0.061)
$\sum_b \omega_{ib}\ Exposed_b\ (\mathcal{S}_{bc} = 0)$				-0.220**
				(0.086)
Firm FE	Yes	Yes	No	No
Country-Product FE	–	–	Yes	Yes
Obs	10,334	10,334	14,208	14,208
R^2 adj	0.63	0.63	0.438	0.438

Note: Columns 1 and 2 show results of the within-firm specification in 8. $\Delta L_{ib} \equiv \ln L_{ibPost} - \ln L_{ibPre}$ is the change in bank-firm credit, $Exposed_b$ is a dummy equal to 1 for exposed banks–i.e., bank-b's share of foreign debt in 2006 is above the system's mean–, and $(C_i^x \in Set(\mathcal{S}_b) > 0)$ is a dummy equal to one if, in the Pre period, the firm exports to a country that belongs to the set of specialization of the bank (i.e., set of countries with positive $\mathcal{S}_{bc}$)). Standard errors clustered at the bank level. Columns 3 and 4 show results of specification in 9. $\sum_b \omega_{ib} Exposed_b$, with $\omega_{bi} \equiv L_{ib}/\sum_b L_{ib}$, is firm-$i$'s share of credit with exposed banks. In column 4, $\sum_b \omega_{ib} Exposed_b(\mathcal{S}_{bc} = 0)$ is the share of firm-i's share of credit with exposed banks non-specialized in country c, and $\sum_b \omega_{ib} Exposed_b(\mathcal{S}_{bc} > 0)$ is the share of credit with exposed banks, with positive specialization in country c. Standard errors clustered at the product-destination level. ***p$<$ 0.01, **p $<$ 0.05, and *p $<$ 0.1.

Appendix: Proof of Result 1

Proof. Notice that $\sum_{k=1}^{J} S_{bk} = 1$. Since $\gamma_{kb} = \gamma_{kb'}$ for all $k \neq j, j'$, follows that $S_{bj} + S_{bj'} = S_{b'j} + S_{b'j}$. Then,

$$\frac{\sum_{i=1}^{I} L_{ib} \left(X_{ij} + X_{ij'}\right)}{\sum_{i=1}^{I} L_{ib'} \left(X_{ij} + X_{ij'}\right)} = \frac{\sum_{k=1}^{J} \sum_{i=1}^{I} L_{ib} X_{ik}}{\sum_{k=1}^{J} \sum_{i=1}^{I} L_{ib'} X_{ik}}$$

Follows that:

$$\frac{S_{bj}}{S_{b'j}} = \frac{\sum_{i=1}^{I} L_{ib} X_{ij}}{\sum_{i=1}^{I} L_{ib'} X_{ij}} \cdot \frac{\sum_{i=1}^{I} L_{ib'} \left(X_{ij} + X_{ij'}\right)}{\sum_{i=1}^{I} L_{ib} \left(X_{ij} + X_{ij'}\right)}$$

which is bigger than one as long as $\sum_{i=1}^{I} L_{ib} X_{ij} \cdot \sum_{i=1}^{I} L_{ib'} X_{ij'} > \sum_{i=1}^{I} L_{ib'} X_{ij} \cdot \sum_{i=1}^{I} L_{ib} X_{ij'}$. This condition is always satisfied for $\gamma_{bj} = \gamma_{b'j'} > \gamma_{bj'} = \gamma_{b'j}$. □