Comparative Advantage and Specialization in Bank Lending *

Daniel Paravisini Veronica Rappoport Philipp Schnabl

LSE, CEPR, BREAD LSE, CEP NYU Stern, NBER, CEPR

October 23, 2014

Abstract

We develop an empirical approach for identifying comparative advantages in bank lending. Using matched credit-export data from Peru, we first uncover patterns of bank specialization by export market: every country has a subset of banks with an abnormally large loan portfolio exposure to its exports. Using outliers to measure specialization, we use a revealed preference approach to show that bank specialization reflects a comparative advantage in lending. 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. Bank comparative advantages increase with bank size in the cross section, and in the time series after mergers. Our results challenge the perceived view that, outside relationship lending, banks are perfectly substitutable sources of funding.

*We thank Luana Zaccaria for excellent research assistance. 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. If banks have quantitatively important comparative advantages in funding specific markets or economic activities, then a bank failure will have first order effects on the real output of the market or activity in which the bank is specialized. 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 banks will be misleading if comparative 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 and develop an empirical method to relate the specialization measure to banks' comparative advantages in lending. We apply the methodology in the context of the funding of export activities in Peru, where banks may specialize and have comparative advantages 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. We use this fact 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 total 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. Mea-

suring 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

Using this measure we uncover the patterns of bank specialization by export market. Every bank in the sample is specialized in an least one country during the sample period between 1994 and 2010, and 94% of the banks remain specialized in the same country for over half of the observed sample period. Specialization does not vary systematically with bank size, although large banks are relatively more specialized in larger export markets. Across countries, specialization is positively correlated with the size of the destination market. In panel regressions with bank and country fixed-effects, we find that foreign banks tend to specialize in the country where its headquarters are located. Finally, we find that lending specialization is not unique to export destination markets: banks also specialize along broad product categories.

The observed patterns of specialization are consistent with the existence of comparative advantages in lending across markets or sectors of economic activity. In the second part of the paper we test whether banks have a comparative advantage in funding exports to the markets they specialize in. In the context of the financing of exporters, a bank has a comparative 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, presence in the destination country, etc.) than other lenders. Since we do not observe firm demand for credit nor the value added services provided by banks, we adopt a revealed preference approach to identify comparative advantages. 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 comparative advantage 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 (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 is correlated with credit variation from banks specialized in that country.

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 (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 firms 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 correlation 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

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

their borrowing by 63% 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. The result is robust to alternate definitions of specialization, to measuring specialization based on products instead of countries, and to instrumenting changes in firm exports with macroeconomic innovations in the country of destination, i.e. GDP growth and real exchange rate movements. We also find that the propensity to borrow from the specialized banks is larger for larger banks in the cross section and in the time series after mergers. This implies that the source of comparative advantage is scalable and unhindered by organizational constraints.

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 comparative advantages in lending. We find that even though specialization is correlated with country of ownership, comparative advantages are not explained by geography. We discuss additional evidence that highlights the challenges of pinning down the source of comparative advantages in bank lending.

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 banks' advantage is specific to certain markets or economic activities, and thus funding *across* financial intermediaries is less-than-perfectly substitutable. Further, the results suggest that the market-specific advantages are distinct from the firm-specific advantage conferred by proprietary information gathered through the lending process (see James, 1987; Takeo Hoshi and Scharfstein, 1990; Petersen and Rajan, 1994; Berger and Udell, 1995; Degryse and Ongena, 2005, Chava and Purnanandam, 2011; for surveys see Boot, 2000 and Ongena and Smith, 2000; Bolton et al., 2013). The lending comparative advantages documented in this paper do not suffer the

trade-off between relationship lending advantages and bank size theorized in Stein (2002) and documented in Berger et al. (2005).

Our results also provide 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.

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 strategy for identifying the lending supply channel, by absorbing demand for credit with firm-time fixed effects, relies on firm credit demand to be, in expectation, equally spread across all banks lending to the firm (see, for example, Khwaja and Mian, 2008; Paravisini, 2008; Schnabl, 2012; Jimenez et al., 2014; Chodorow-Reich, 2014). In the presence of bank specialization, this assumption only holds for certain kinds of shocks 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]

Finally, our paper sheds light on 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.

[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.

The rest of the paper proceeds as follows. Section 2 describes the data. Section 3 characterizes bank lending composition according to the export activities of related firms. Section 4 discusses the empirical strategy to identify banks' comparative advantage and presents the results. Finally, section 5 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. Figure 1 shows Peruvian exports during the period under analysis.

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 4 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.

The composition of Peruvian exports by destinations is shown in Figure 2. We restrict the export destination to the main 22 markets, which represent 97% of Peruvian exports across the entire period of analysis.[3]

In subsection 4.5 we also use supporting macroeconomic data for Peru's main 22 export partners. The series of real GDP (series 99BVRZF), nominal exchange rate (series AH.ZF), and consumer price index (series 64.ZF) are from IFS/IMF, with the exception of CPI series from China and Chile, which are from the corresponding national statistics bureau.

3 Bank Lending Specialization: Stylized Facts

In this section we characterize bank lending composition according to the export activities of related firms. We show that the lending composition differs markedly across banks, and that some banks heavily concentrate their lending portfolios in firms exporting to specific destinations.

3.1 Methodology and Definitions

To measure lending concentration and specialization we begin by defining the share of bank-b's loans associated to a given export destination. Let $c = 1, ..., C$ be the destination country of exports by Peruvian firms. 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

[3]The included countries are Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, China, Colombia, Denmark, Ecuador, France, Germany, Italy, Japan, Korea, Netherlands, Panama, Spain, Switzerland, United Kingdom, United States, and Venezuela.

exports. That is:

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

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 2 for the country composition of Peruvian exports). We are interested in banks' departures from the overall specialization pattern of Peruvian exports. That is, the difference between the bank's share of lending associated to a given country and the average across banks, $\overline{S}_{ct}$. This intuition is the base of the *Relative Concentration Index* developed by Krugman (Krugman (1991)):

$$K_{bt} \equiv \sum_{c=1}^{C} \left| S_{bct} - \overline{S}_{ct} \right| \tag{2}$$

Intuitively, the Krugman index measures the overall reallocation of bank-b's lending across associated export markets that would be necessary to replicate the banking system's average.[4] The Krugman index takes a value of zero when the distribution of the bank's loans across destinations is equal to that of the entire banking system. On the other extreme, if a bank's loans are fully concentrated in a single destination market, the index attains its maximum value $2(C-1)/C$, where C is the total number of countries.

While the Krugman index summarizes the distribution of loans across countries into a single bank-time statistic, we are interested in characterizing *specialization* at the bank-country level: 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.

[4] See Palan (2010) for a description of this index in connection with alternative definitions.

To illustrate the approach, we depict with a box-and-whisker plot in Figure 3 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." [5] The outliers 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.*

3.2 Initial Stylized Facts

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-level export data to the 22 largest export destination markets.[6]

The values of S_{bct} defined in (1) 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 system's average share in the corresponding country, $\overline{S}_{ct}$. The

[5] 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.

[6] 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).

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 3). This implies that for every destination country in the sample there are always some banks that are heavily specialized in its related exports .

Table 3, column 1 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. These figures are reported in columns 2, 3, and 4 respectively. 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 order to be considered specialized, 25 out of 31 banks in the sample are specialized in at least one country. These findings are summarized in the following stylized fact:

Fact 1. *The country-specific distribution of associated bank loans is right skewed. Every country has a subset of heavily specialized outlier banks.*

We define a second measure of specialization, $\mathcal{S}_{bc}$, that takes into account the heterogeneity in specialization persistence observed in Table 3: it is defined as the percentage of years in the sample that the bank is an outlier of the distribution of lending associated to a given country. This measure of specialization is time invariant and it is our preferred definition in the empirical analysis in the next section. For every bank-country pair bc we define:

$$\mathcal{S}_{bc} \equiv \frac{1}{t_b^F - t_b^0} \sum_{t=t_b^0}^{t_b^F} O(S_{bct}) \tag{3}$$

where t_b^0 and t_b^F are the first and last year that bank b is active within the 17-year period in our sample.

Table 4 shows the descriptive statistics of this index. For each bank, the mean across the 22 countries of destination is very low, smaller than 0.2 in all cases (column 1). This is because each bank is only specialized in small number of countries; for most countries c, the index $\mathcal{S}_{bc}$ is equal to zero. Indeed, with the exception of 3 out of 31 banks, the median $\mathcal{S}_{bc}$ across countries is zero (column 4). However, all banks have long-lasting specialization in at least one country. Column 5 shows the maximum proportion of years bank b is specialized in a given country: 13 out of 31 banks are specialized in at least one country for the entire period (i.e. $\max_c\{\mathcal{S}_{bc}\} = 1$), and 31 do so for at least 50% of their active years in the sample (i.e. $\max_c\{\mathcal{S}_{bc}\} \geq 0.5$). These results are summarized in the following fact:

Fact 2. *Banks specialize in a small number of countries. And there is a subset of countries in which banks exhibit long-lasting specialization, in the sense that the bank specializes in that country during at least 50% of their active years in the sample.*

We further characterize specialization by analyzing how it varies across bank characteristics. First, we characterize bank-country specialization across banks heterogenous in size. Table 5 shows that bank size (measured by total outstanding debt) or foreign ownership are not correlated with the index of bank-country specialization (column 1). Banks are more likely to be specialized in large export markets, measured by total exports (column 2).[7] And, controlling for bank size and country size with bank and country fixed effects, there is a mapping between the size of the country and the size of the bank: larger banks are relatively more specialized in larger export markets (column 3). These findings are summarized in the following fact:

Fact 3. *Specialization does not systematically vary across banks of different size. But bank size is still an important factor behind the pattern of specialization: larger banks are relatively more specialized in larger export markets.*

[7] This fact coincides with the findings in Niepmann and Schmidt-Eisenlohr (2014). Using data from U.S. banking system, it finds that more banks participate in trade-finance (i.e. letters of credit) with larger export markets.

Second, we explore how the bank-country specialization patterns relate to the country of ownership of global banks or the country where their subsidiaries are located. Table 5, column 4, shows the correlation between bank-country specialization index and: 1) $CountryOwnership_{bc}$, a dummy equal to 1 if bank b's headquarters are located in country c, and 2) $CountrySubsidiary_{bc}$, a dummy equal to 1 if bank b has a subsidiary in country c in 2004.[8] We find that specialization and country of ownership are correlated: the mean bank-country specialization index, which is 0.10 for the entire sample (column 1 in Table 4), is 0.06 higher in bank's country of ownership. Having a subsidiary in a country, on the other hand, is uncorrelated with bank specialization in that country. We further explore the connection between specialization, country of ownership, and comparative advantage in Subsection 4.4. The following fact summarizes these results:

Fact 4. *Foreign banks are more likely to specialize in the country where their headquarters are located. Specialization is uncorrelated with the countries where the bank's subsidiaries are located.*

The index of specialization $\mathcal{S}_{bc}$, defined in equation 3, has two advantages. First, it is a bilateral bank-country measure so it can be distinguished from any omitted bank wide characteristic. And second, it varies with specialization (from definition 1) and its persistence over time. The advantages of this measure become evident once we compare it with the information extracted from the Relative Concentration Index defined in 2 (the Krugman Index).

Table 6 shows the descriptive statistics of K_{bt}, overall and by bank. The average is 0.75, which indicates that banks' associated export distribution across countries diverge systematically from the system-wide average. The degree of lending concentration varies substantially in the data: the index varies from 0.16 to 1.86 covering almost the entire potential range (with 22 countries, the maximum potential value is 1.91). A decomposition of the standard deviation into its between (variation across bank means) and within (variation over time for a given bank, averaged over all banks) indicates that the between variation (Std. Dev. = 0.37) accounts for most of the heterogeneity in lending concentra-

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

tion. Figure 5(a) shows the Krugman index by size of the bank, measured as average total loans outstanding. Smaller bank are more concentrated. Figure 5(b) shows the average change in the Krugman index plotted against average loan growth. There appears to be a negative correlation between changes in concentration and bank growth. This results are summarized in the following fact:

Fact 5. *The concentration of portfolio loans, relative to the system's average, varies systematically with size. Larger banks (both in the cross-section or, for the same bank, as it grows) have a more diversified portfolio, that converges towards the system's average.*

Big banks, with larger number of borrowers, are more diversified and have a portfolio of loans that is closer to the system's average. The portfolio of small banks, on the other hand, is more sensitive to new lending or changes in export activities of related firms. Moreover, having a small number of clients, the portfolio shares can exhibit large departures from the system's average. Notice that, while the Index of Relative Concentration is lower for larger banks, the bank-country index of specialization, $\mathcal{S}_{bc}$ defined in (3), is not (Fact 3). In other words, even though the concentration of loans across associated destination countries converges towards the system's average, banks maintain constant the number of countries in which they specialize as they expand in size.

End this section by exploring whether the specialization patterns we have uncovered are specific to the destination market of the exports. We use the customs data to define a market of specialization by fifteen broad product categories, indexed by p, based on the first two digits of the Harmonized Commodity Description and Coding System (HS). We repeat all the calculations above based on the distribution of bank's associated lending shares across product categories, $\mathcal{S}_{bp}$. We find that facts 1 and 2 also hold across product markets (see the tables in the Appendix). This suggests that the bank specialization patterns that we have uncovered are not unique to geographical markets, but extend to the types of products firm produce.

To explore whether country and product specialization are independent, we perform the following exercise: we use the bank-product shares $\mathcal{S}_{bp}$ and the fraction each prod-

uct represents in each country's total exports to predict bank-country shares $\hat{\mathcal{S}_{bc}}$.[9] Consider a simple hypothetical example with two products and two countries: suppose a bank's lending is associated 90% with mineral product exports and 10% of the other good ($\mathcal{S}_{p=mineral}$=0.9 and $\mathcal{S}_{p=other}$=0.1). Suppose also that 90% of Peru's total mineral exports go to the U.S. and that 50% of the other good's export go to the U.S. Then $\hat{\mathcal{S}_{c=US}} = 0.9 \times 0.9 + 0.1 \times 0.5 = 0.86$, or in words, we predict that 86% of the banks exports will be exported to the U.S.

There is a very high correlation between the banks actual country shares and the predicted ones ($Corr(\mathcal{S}_{bpt}, \hat{\mathcal{S}_{bpt}}) = 0.59$). On the one hand, the high correlation implies that a measure of specialization using one market definition may be a good proxy for specialization along many dimensions. This fact may become useful in settings where data limitations do not allow measuring specialization along all relevant market definitions. On the other hand, the high correlation highlights the inherent difficulty in disentangling the sources of specialization and comparative advantage, an issue the we discuss further in the next section. These results are summarized in the following fact:

Fact 6. *Banks also specialize across product categories. A bank's product specialization and country specialization are highly correlated through the aggregate product-destination export patterns.*

In short, our analysis uncovers new patterns of banks' lending: banks specialize in the export markets of related firms, in the sense that the share of their lending associated to firms that export to a given destination is an outlier in the distribution of loans associated to that country, across all banks in the system. Moreover, each bank is associated with a subset of countries for which they exhibit long-lasting specialization. Specialization patterns persist as banks expand in size and diversify their portfolio, and are robust to alternative definitions of the product market.

The specialization patterns above are interesting if they are related to a *comparative advantage* in lending to finance export projects towards the countries of specialization. The

[9] Specifically, we multiply the bank-product shares $\mathcal{S}_{bp}$ by the fraction each product represents in each country's total exports, and then add across products for each country to obtain the predicted bank-country share.

rest of the paper is devoted to identifying and characterizing bank patterns of comparative advantages in lending to exporters.

4 Identifying Comparative Advantages in Lending

In this section we develop an empirical approach that allows assessing whether bank specialization in a country is an indicator of its comparative advantage in lending to exporters to that destination. In the context of the financing of exporters, a bank has a comparative 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 evaluating comparative advantages. Under the null hypothesis that banks do not have comparative 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. In the Appendix we provide a simple partial equilibrium framework that formalizes the intuition for why bank comparative advantages lead to such a positive association. 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.

It is important to highlight that our approach tests a joint hypothesis: that banks have comparative 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., 2014).[10]

4.1 Empirical Strategy

This section describes our empirical approach for identifying the relative advantage of specialized banks in providing credit to firms exporting to the bank's target markets. 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

[10] 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).

destination market c) increases in $\mathcal{S}_{bc}$ (a measure of specialization of bank b on destination market c).

In the baseline specification we use the time-invariant measure of specialization: the fraction of years in the sample in which bank b is an outlier in the loan distribution associated to country c, i.e. $\mathcal{S}_{bc} = \overline{O(S_{bct})}$ in equation 3. Although we do test for the robustness of the results using time-varying definitions of specialization, we prefer the estimates using the time-invariant measure because they avoid introducing spurious correlation between the time-varying outstanding firm-bank debt, L_{ibt} and the measure of bank-country specialization.

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:

$$\ln L_{bit} \quad = \quad \alpha_b^c + \alpha_{it}' + \alpha_{bt}'' + \beta_1 \ \ln X_{it}^c + \beta \ \mathcal{S}_b^c \times \ln X_{it}^c + \epsilon_{ibt}^c \tag{5}$$

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 (5), one for each country c in our analysis sample. To estimate the parameters of (5) we stack the observations for all countries and adjust the standard errors for clustering at the bank 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 $\mathcal{S}_b^c$, 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.

In theory it would be possible to include a full set of bank-firm-country fixed-effects in the regression. However, estimation of this model is not computationally feasible in the full sample due to the large number of fixed effects (bank-firm-country, bank-time, firm-time). The results and conclusions below are robust to three different estimation approaches aimed at accounting for the unobserved variation at the bank-firm-country (not shown): 1) estimating the baseline specification with firm-bank-country fixed effects on random 5% firm sub-sample of firms, 2) estimating the baseline specification demeaning all right-hand side and left-hand-side variables at the firm-bank-country, 3) estimating the baseline specification demeaning $\ln L_{bit}$ and X_{it}^c only.[11]

Our coefficient of interest is β. A coefficient $\beta > 0$ indicates that, for a given firm, the correlation between its exports and outstanding debt is higher with banks specialized in the country of destination. 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 $\beta = 0$.

4.2 Baseline Results

In this subsection we use the methodology described above to evaluate whether specialized banks have a comparative advantage in lending. We present the OLS estimates of 5 in Table 7. Column 1 presents the the baseline regression with specialization $\mathcal{S}_b^c$ measured as the fraction of sample years that bank b is an outlier in the distribution of loans associated to destination country c.

The coefficient on (log) exports is positive and significant. This coefficient captures the correlation between the firm-bank specific component of debt and the firm's average

[11]The first-differenced estimates of specification 5 produce very noisy estimates on all parameters. We ommit presenting these results because we cannot evaluate whether this is because first-differencing exacerbates the influence of measurement error or because comparative advantages manifest themselves with lags.

exports *to the countries in which bank b is not specialized in*.[12] The positive coefficient implies that during credit supply expansions banks allocate more credit to firms that expand exports more to countries outside the bank's markets of expertise, with elasticity 0.026. Note that this coefficient does not have a causal interpretation: a positive correlation may arise if firms expand exports more because they receive more credit, or alternatively, because banks extend the marginal credit to firms that grow more because export growth is correlated with firm quality or riskiness.

Our coefficient of interest on the interaction between log exports and the specialization measure is 0.016 and significant at the 1% level. This indicates that the correlation between credit and exports is significantly larger when the bank issuing the debt is specialized in the destination country. The coefficient implies that the correlation is 61% higher for a bank that has been specialized in the country for the full sample period ($\mathcal{S}_b^c$=1) relative to one that has not been specialized in the country at all ($\mathcal{S}_b^c$=0).

This result is consistent with banks having a comparative advantage in funding the export activities to the countries in which the bank specializes. Comparative advantage 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. In the next subsection we provide estimates when we restrict the credit variation to be driven exclusively by shocks to export markets.

For robustness, columns 2 through 4 in Table 7 show the results of specification 5, using alternative definitions of bank specialization. In column 2 we define a bank to be specialized in a country if $\mathcal{S}_b^c > 0.5$, that is, if the bank appears as an outlier in the exposure

[12]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.

distribution for that country over half the length of the sample period. This is stricter than the baseline definition, because a bank is considered to be specialized only if its exposure to a country is persistent (see descriptive statistics of this measure in Table 3, column 3).

In columns 3 and 4 we use time-varying definitions of specialization. The time-varying indicator of specialization is not absorbed by the time-invariant fixed effects, and it is therefore added as another right-hand-side variable. In column 3, we use as a definition of specialization the dummy $\mathcal{S}_{bt}^{c} \equiv O(S_{bct})$ in definition 1, equal to one if bank b is an outlier in the distribution of loans associated to destination country c in year t. In column 4, specialization is defined according to the *presence* in year t of bank b in export activities to country c, $\mathcal{P}_{bct}$. This measure does not rely on the actual outstanding debt of the firms, but only on their exports. This way, the intensive margin of lending, L_{bit}, does not enter in the construction of this specialization measure, which is defined as follows:

$$\mathcal{P}_{bct} = \frac{\sum_{i=1}^{I} D(L_{bit} > 0)\, X_{ict}}{\sum_{c=1}^{C} \sum_{i=1}^{I} D(L_{bit} > 0)\, X_{ict}} \tag{6}$$

where $D(L_{bit} > 0)$ is a dummy equal to one if firm i has positive outstanding debt in bank b at time t. Then, a bank b is specialized in country c in year t if $\mathcal{P}_{bct}$ is an outlier in the corresponding country-year distribution; that is $\mathcal{S}_{bt}^{c} \equiv O(\mathcal{P}_{bct})$.

The results from estimating these robustness regressions are qualitatively and quantitatively equivalent to those from the baseline estimation. The elasticity of debt to exports for banks specialized in the destination country is always higher than for non-specialized banks, and the magnitude of this difference varies from 58% (column 2) to 47% (column 4) depending on the definition of specialization.

Finally, in Table 7, columns 5 and 6, we replicate the estimation in columns 1 and 2 but instead of constructing the specialization measures based on the actual bank shares by country, S_{bct}, we use the country shares predicted using the product shares, $\hat{S_{bct}}$, as defined at the end of Subsection 3.2. The results are statistically indistinguishable from those in the baseline regression. This implies that the comparative advantage results are

robust to defining specialization based on product markets instead of geographical markets. This represents good news in terms of the applicability of the methods developed in this paper in contexts with limited data availability. For example, a firm classification into coarse industry groups may be enough to obtain measures of bank specialization that are meaningful for reflecting the bank's pattern of comparative advantage. As we noted before, the disadvantage of the high correlation is that between the two definitions is that it will hinder identifying the sources of comparative advantage. For example, finding that a bank is specialized in the mineral products may reflect a comparative advantage of the bank in that industry, or may reflect a comparative advantage in the market where mineral products are sold (or both may reflect a comparative advantage in some other unobservable capital or product market dimension). The results call for caution in interpreting the observed correlation between specialization measures and comparative advantage as causal.

4.3 Comparative Advantage and Size

In this subsection we explore the relationship between bank comparative advantages and size. The exercise is motivated by the theoretical framework in Stein (2002), which suggests there is a trade-off between bank size and the comparative advantages that banks generate through relationship lending. The reason is that the source of comparative advantage is information that is difficult to communicate across hierarchical layers of the organization (*soft* information). In contrast, if the source of comparative advantage is scalable —as is assumed in the model presented in the Appendix— not only will comparative advantages persist for large banks, but the banks with larger comparative 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.

We already uncovered Fact 3 that the pattern of specialization does not vary with bank size. However, different banks may have different motives to diversify their investments.

Heterogeneous diversification motives may limit what we can infer from the cross section of diversification. Thus we evaluate whether the link between comparative advantage and specialization is higher for small than for large banks.

We test this hypothesis in the cross-section of banks by estimating specifications 5 augmented with the interaction of $Small_b$, a dummy equal to 1 if b is not one of the top 10 largest institutions measured in total loans over the full sample period. 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.

The results are reported in column 1 of Table 8. The coefficient estimate on exports interacted with specialization is similar to that in the baseline specification in Table 7. This implies that the largest 10 banks in Peru have a significant comparative advantage in lending to the countries in which they specialize in. The coefficient of the interaction with $Small_b$ is negative and statistically significant, indicating that smaller banks enjoy smaller comparative advantages in lending. Although the point estimate is noisily estimated, its magnitude suggests that smaller banks may have very small comparative advantages or none at all.

We also evaluate the relationship between size and comparative advantage around mergers. To evaluate how the comparative advantage in the country of specialization of the merged entities change after a merger, we modify the data and specification 5 to perform event studies around the years were bank mergers take place. 8-year interval subsamples around the time of the merger, 4 before and 4 after the event, are drawn from the original data and stacked to perform a single estimation. We use as an (time-invariant) indicator of bank specialization the outlier variable in definition 1, $\mathcal{S}_b^c = O(S_{bct})$, computed the year before the merger. 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 bank 1 is specialized in country A and bank 2 is specialized in country B, then the combined entity is considered to be specialized in A and B before the merger).

We estimate specification 5 on the stacked data for all the merger events, 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). We first replicate the estimation of (5) without the merger interaction terms to corroborate that the point estimates are robust to the change in sample and specification (Table 8, column 2). The coefficient on the term $\mathcal{S}_b^c \times \ln(X_{it}^c)$ is positive and significant, although somewhat smaller in magnitude than in the baseline result. However, the relationship between the interaction term coefficient and that on exports is larger. 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.

The results with the merger interaction are shown Table 8, column 3. 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 specialization and comparative advantage in lending changes after the merger. The point estimate is positive but statistically significant only at the 10% level. The result rules out that the merger diminishes the comparative advantage in lending of the pre-merger entities. The same conclusion holds if we separately evaluate the effect of the merger on the comparative advantage associated to countries in which the *target* bank specialized before the merger (not shown).

These results imply that banks retain their comparative advantage in their markets of specialization even as they grow larger and more diversified. The source of comparative 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 Bank Country of Ownership

We analyzed in Subsection 3.2 the relationship between banks' pattern of specialization and country of ownership. For foreign banks, the country of ownership is, on average, a country of specialization (Fact 4). Country of ownership, however, is not a sufficient

statistic for specialization. First, domestic banks also specialize in export markets. And second, foreign banks specialize in other countries beyond the country of ownership. In this subsection we explore whether country of ownership represents all the source of comparative advantage in export destinations, in which case our measure of specialization would be a redundant variable, only significant when country of ownership is omitted from the regression.

We explore this possibility by expanding the baseline regression in (5) with the interaction term $CountryOwnership_b^c \times \ln(X_{it}^c)$. $CountryOwnership_b^c$ is a dummy equal to 1 if the location of the bank's headquarters coincides with the export destination. The results are shown in column 4 of Table 9. The coefficients on $\ln(X_{it}^c)$ and $\mathcal{S}_b^c \times \ln(X_{it}^c)$ are of the same magnitude and significance as in the baseline regression. Country of ownership does not capture at all the source of comparative advantage for international banks; the coefficient on the interaction term $CountryOwnership_b^c \times \ln(X_{it}^c)$ is not statistically significant at the standard levels.

Country of ownership alone may be too coarse a measure to capture comparative advantages. We explore whether the following bilateral relationships between the country of export destination and the country of ownership of the bank can explain some of the observed comparative advantages: 1) distance, 2) commonality in language, and 3) a past colonial relationship. We obtain these bilateral measures from Mayer and Zignago (2011) and include their interaction with (log) exports in the specification. None of the estimates on these interaction terms, presented in Table 9, column 2, is statistically significant, and their inclusion in the regression does not change the magnitude or the significance of the interaction of exports and specialization. The interaction term with $CountrySubsidiary_b^c$, a dummy equal to 1 if bank b has a subsidiary in country c in 2004, is also not statistically significant. We conclude that, even though our specialization measure is correlated with the bank's country of ownership, banks' comparative advantage cannot be summarized as a home-country advantage.

4.5 Export Shocks

In this final subsection we provide an estimate of the comparative advantage of specialized banks to a demand shock in the specialization market. Peruvian exports are expected to increase if the destination country experiences an economic expansion or if its prices increase relative to Peruvian ones (a real appreciation relative to Peru). The correlation between GDP growth, real exchange rate, and exports is presented in column 1 of Table 10. This exercise is similar to the gravity equation estimates in Fitzgerald and Haller (2014), which uses firm-destination-year export data from Ireland and absorbs any firm-level change in costs or productivity with firm-time fixed effects. Consistent with the literature, the export elasticity to real exchange rate is positive and significant but lower than 1. Positive GDP shocks also significantly affect the value of exports for those firms that are already exporting to that destination (i.e. intensive margin).[13] We use these macroeconomic innovations as a source of variation for firm exports to the corresponding destination country.

As emphasized in the introduction, in the presence on bank specialization it is difficult to disentangle demand from supply shocks. Shocks to an export market will very likely affect the demand for export credit (e.g. by increasing the demand for working capital required to sustain an expansion in exports) and the supply of export credit (e.g. because the balance sheets of specialized banks have a large exposure to the export market that receives the shock). The supply and demand channels will move the bank-firm specific component $\mathcal{L}_{bit}$ in equation 4 in the same direction *only if* the bank assigns the it's marginal dollar of debt to activities it has a comparative advantage in. This will not be the case in most simple models of comparative advantage. In the stylized model in the Appendix, for example, changes in the cost of capital of the bank do not affect lending differentially for specialized and non-specialized activities. The simple framework implies that supply shocks cannot lead to the observed excess correlation between lending by

[13] See also Berman et al. (2012) for the effect of real exchange rate shocks on exports using firm-country panel data for French firms.

specialized banks and exports to the country of specialization. In the likely scenario that activities in which the bank has a comparative advantage are infra-marginal (e.g. when banks face a liquidity shortage they cut funding first to activities in which they do not specialize in) the supply and demand shocks will have opposing effects on the relative credit provided by specialized banks.

This argument serves as justification for an instrumental variable estimate of specification 5 using GDP growth and the real exchange rate as instruments for exports to a destination country. If credit supply shocks do not affect lending differentially for specialized and non-specialized activities, the supply effect will be captured by the bank-time dummies, and the coefficient on the interaction between exports and specialization can be interpreted as demand driven. If it affects disproportionately non-specialized markets (non-specialized markets are marginal) then the coefficient estimate will be biased downwards.

Columns 2 and 3 in Table 10 show the first-stages and corroborate that there is a strong and positive association between exports, and GDP growth and real exchange rate in the destination country. There are two first stages: one for exports and one for exports interacted with specialization. The interactions between GDP growth and real exchange rate with specialization are also included as instruments in both first stages. Column 4 shows the results of the IV estimation. The coefficient on (log) exports is 0.34, and the coefficient on its interaction with specialization is 0.12. The positive coefficient most likely has a demand interpretation: when firms wish to fund an export expansion to country c, they demand more credit from banks that are specialized in country c. Since the supply effect most likely biases the estimate downwards, the point estimate represents a lower bound of the relative effect of a credit demand shock between specialized and non-specialized banks. The relative magnitude in the IV estimation implies that firms demand 33% more credit from specialized banks than non-specialized ones when expanding exports. This result is consistent with the existence of a comparative advantage in lending by specialized banks.

The point estimates of the IV specification are an order of magnitude larger than those obtained in the baseline specification. The coefficient of 0.026 on (log) exports, $\ln(X_{it}^c)$, in the baseline specification implies that variation in exports explains, in a statistical sense, a small part of the variation in total credit (a 10% increase in exports to one particular destination is on average associated with a 0.2% increase in firm borrowing). The interpretation of the magnitude of the estimated correlation is blurred by the fact that firm's demand for credit for reasons other than funding exports. The IV point estimates, on the other hand, capture changes in debt that can be associated with export shocks. The IV point estimates implies that a 10% increase in exports to country c is associated with a 3.4% increase in export-related debt issued by banks that are not specialized in country c, and a 4.6% increase in export-related debt by banks that are specialized in country c. The relative magnitude of the IV and OLS estimates suggests that about one-tenth of the credit variation in the data is directly related to exporting activities (after saturating the firm-time and bank-time variation).

5 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 to a destination country is heavily right 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 a comparative advantage of providing funding for export activities to 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.

The findings have implications in four areas of the banking literature. First, since our

results show that banks are not substitutable sources of finance, they imply that bank failures, even isolated ones, may have first order consequences on the supply of credit in the sector of specialization of the failed bank. Second, imperfect substitutability also has consequences for the measurement of banking competition. Standard measures of banking competition that are based on banks' spatial location may be misleading. Even banks that are physically close to each other may have market power if they are specialized in sufficiently different activities. Third, comparative advantages in bank lending provide a previously ignored rationale for certain features of modern credit markets, such as loan syndication and multi-bank relationships. And finally, our results highlight the difficultly 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.

Our results also call for caution when interpreting the observed relationship between a measure of specialization and comparative advantage. Specifically, we find that bank patterns of country specialization and product specialization are highly correlated. Thus, it is not possible to say whether banks' comparative advantage comes from country-specific expertise, product-specific expertise, or expertise along an unobservable dimension that is correlated with both (e.g. the bank may have an advantage in dealing with innovative firms, firms with complex technologies or organizational structures, unionized industries, and so forth). Exploring the potential sources of bank lending comparative advantages is a promising, albeit challenging, avenue for future research.

References

Amiti, M. and Weinstein, D. (2011), 'Exports and Financial Shocks', *The Quartely Journal of Economics* **126**(4), 1841–1877.

Berger, A. B. and Udell, G. (1995), 'Relationship lending and lines of credit in small firm finance', *Journal of Business* **68**, 351–381.

Berger, A., Miller, N., Petersen, M., Rajan, R. and Stein, J. (2005), 'Does function follow organizational form? evidence from the lending practices of large and small banks', *Journal of Financial Economics* **76**, 237–269.

Berman, N., Martin, P. and Mayer, T. (2012), 'How do different exporters react to exchange rate changes?', *Journal of Banking and Finance* **127**(1), 437–492.

Bolton, P., Freixas, X., Gambacorta, L. and Mistrulli, P. E. (2013), Relationship and transaction lending in a crisis. BIS Working Paper No. 417.

Bolton, P. and Scharfstein, D. (1996), 'Optimal debt structure and the number of creditors', *Journal of Polotocal Economy* **104**(1), 1–25.

Boot, A. W. A. (2000), 'Relationship banking: What do we know?', *Journal of Financial Intermediation* **9**, 7–25.

Boyd, J. H. and Prescott, E. C. (1986), 'Financial intermediary coalitions', *Journal of Economic Theory* **38**, 211–232.

Chava, S. and Purnanandam, A. (2011), 'The effect of banking crisis on bank-dependent borrowers', *Journal of Financial Economics* **99**(1), 116–135.

Chodorow-Reich, G. (2014), 'The employment effects of credit market disruptions: Firm-level evidence from the 2008-09 financial crisis', *Quarterly Journal of Economics* **129**(1), 1–59.

Degryse, H. and Ongena, S. (2005), 'Distance, lending relationships, and competition', *Journal of Finance* **60**(1), 231–266.

Detragiache, E., Garella, P. and Guiso, L. (2000), 'Multiple versus single banking relationships: Theory and evidence', *The Journal of Finance* **55**(3), 1133–1161.

Diamond, D. W. (1984), 'Financial intermediation and delegated monitoring', *Review of Economic Studies* **51**, 393–414.

Diamond, D. W. (1991), 'Monitoring and reputation: The choice between bank loans and directly placed debt', *Journal of Political Economy* **8**(1), 689–721.

Fama, E. F. (1985), 'What's different about banks?', *Journal of Monetary Economics* **15**(1), 29–39.

Feenstra, R., Li, Z. and Yu, M. (2014), 'Exports and credit constraint under incomplete information: Theory and evidence from china', *The Review of Economics and Statistics* **forthcoming**.

Fitzgerald, D. and Haller, S. (2014), Exporters and shocks: Dissecting the international elasticity puzzle. Federal Reserve Bank of Minneapolis Working Paper.

Hodge, V. and Austin, J. (2004), 'A survey of outlier detection methodologies', *Artificial Intelligent Review* **22**(2), 85–126.

Holmstrom, B. and Tirole, J. (1997), 'Financial intermediation, loanable funds, and the real sector', *Quarterly Journal of Economics* **112**(3), 663–691.

James, C. (1987), 'Some evidence on the uniqueness of bank loans', *Journal of Financial Economics* **19**(2), 217–235.

Jimenez, G., Ongena, S., Peydro, J. L. and Saurina, J. (2014), 'Hazardous times for monetary policy: What do 23 million loans say about the impact of monetary policy on credit risk-taking', *Econometrica* **forthcoming**.

Khwaja, A. and Mian, A. (2008), 'Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market', *The American Economic Review* **98**(4), 1413–1442.

Krugman, P. (1991), *Geography and Trade*, MIT Press, Cambridge, MA.

Leland, H. E. and Pyle, D. H. (1977), 'Informational asymmetries, financial structure, and financial intermediation', *Journal of Finance* **32**(2), 371–387.

Manova, K. (2013), 'Credit constraints, heterogeneous firms, and international trade', *Review of Economic Studies* **80**, 711–744.

Mayer, T. and Zignago, S. (2011), 'Notes on cepii's distances measures : the geodist database', *CEPII Working Paper* **25**.

Niepmann, F. and Schmidt-Eisenlohr, T. (2014), Banks in international trade finance: Evidence from the u.s. Federal Reserve Bank of New York Working Paper.

Ongena, S. and Smith, D. C. (2000), *Performance of Financial Institutions*, Cambridge University Press, chapter Bank Relationships: A review, pp. 221–258.

Palan, N. (2010), 'Measurement of specialization: The choice of indices', *FIW Working Paper* **62**.

Paravisini, D. (2008), 'Local Bank Financial Constraints and Firm Access to External Finance', *The Journal of Finance* **63**(5), 2160–2193.

Paravisini, D., Rappoport, V., Schnabl, P. and Wolfenzon, D. (2014), 'Dissecting the effect of credit supply on trade: Evidence from matched credit-export data', *Review of Economic Studies* **forthcoming**.

Pennacchi, G. G. (1988), 'Loan sales and the cost of bank capital', *The Journal of Finance* **43**(2), 375–396.

Petersen, M. and Rajan, R. (1994), 'The benefits of lending relationships: Evidence from small business data', *Journal of Finance* **49**(1), 3–37.

Rajan, R. (1992), 'Insiders and outsiders: The choice between informed and arm's-length debt', *Journal of Finance* **47**(4), 1367–400.

Rajan, R. and Winton, A. (1995), 'Covenants and collateral as incentives to monitor', *Journal of Financ* **50**(4), 1113–1146.

Ramakrishnan, R. T. S. and Thakor, A. V. (1984), 'Information reliability and a theory of financial inter', *Review of Economic Studies* **51**(3), 415–432.

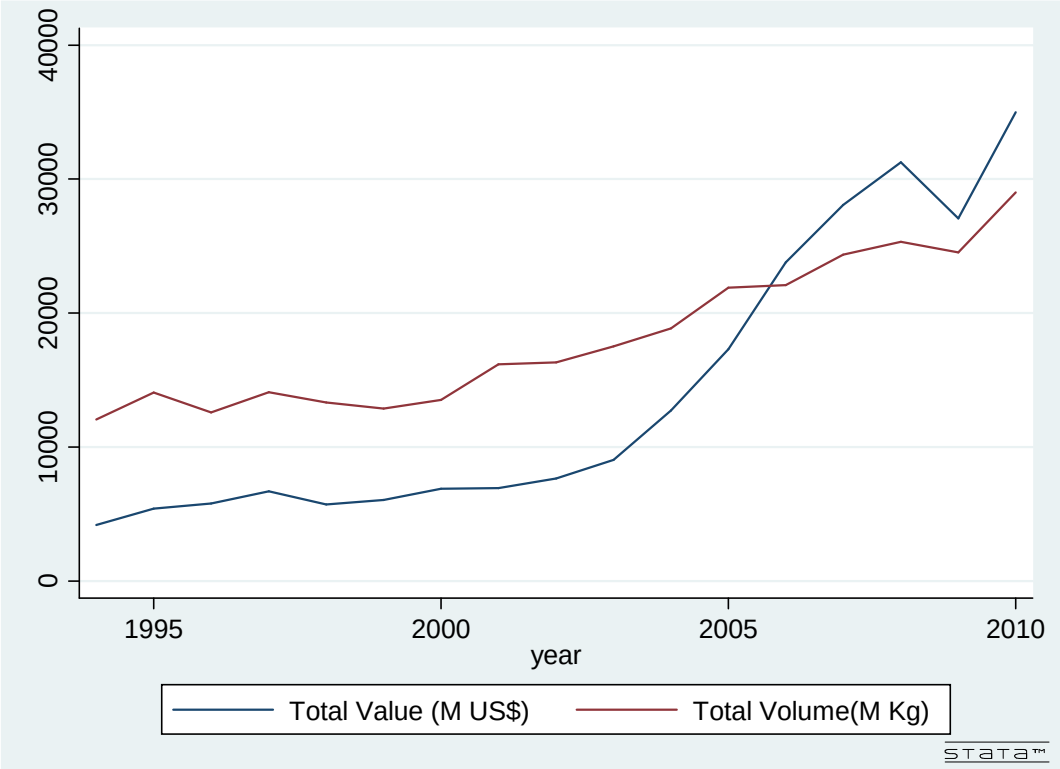
Schnabl, P. (2012), 'The international transmission of bank liquidity shocks: Evidence from an emerging market', *The Journal of Finance* **67**(3), 897–932.

Sharpe, S. A. (1990), 'Asymmetric information, bank lending and implicit contracts: A stylized model of customer relationships', *Journal of Finance* **45**(4), 1069–1087.

Stein, J. (2002), 'Information production and capital allocation: Decentralized versus hierarchical firms', *The Journal of Finance* **57**(5), 1891–1921.

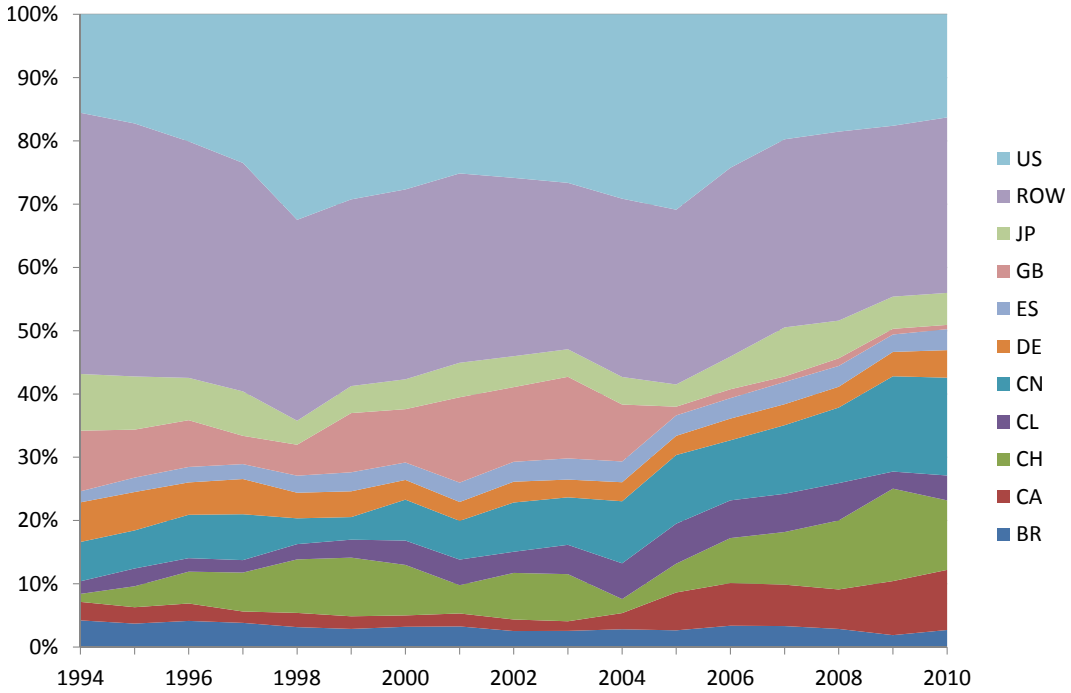
Takeo Hoshi, A. K. and Scharfstein, D. (1990), 'The role of banks in reducing the costs of financial distress in japan', *Journal of Financial Economics* **27**, 67–88.

Figure 1: Total Peruvian Exports



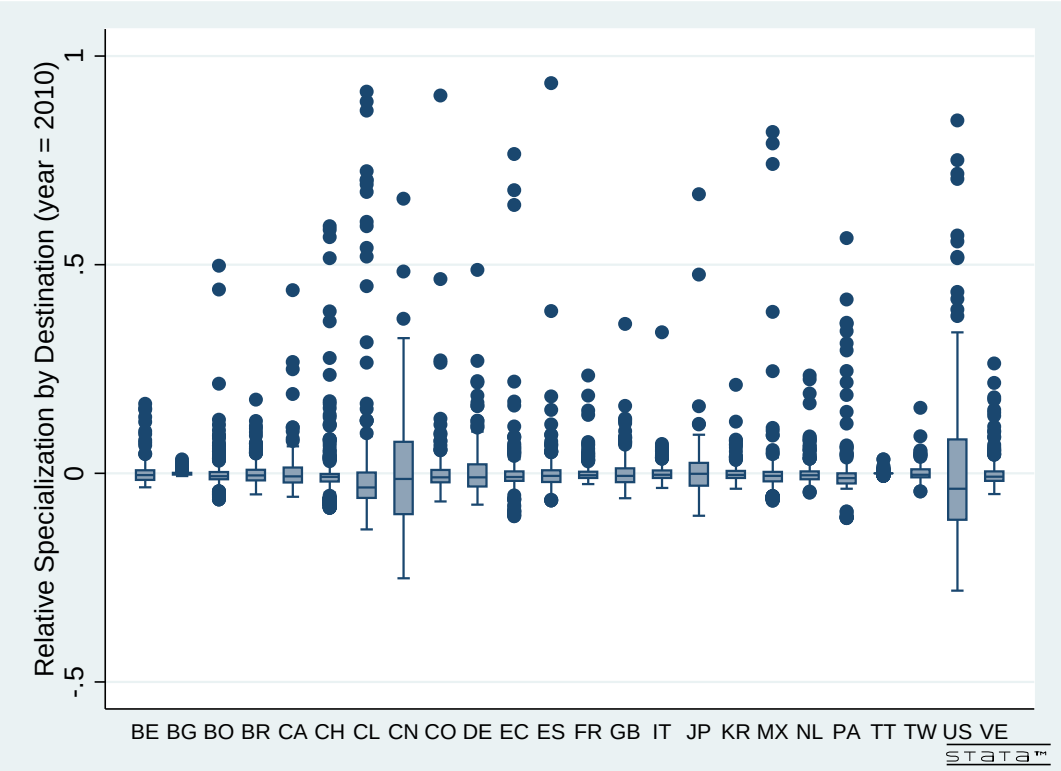
Source: SUNAT

Figure 2: Composition of Exports (Value) by Destination



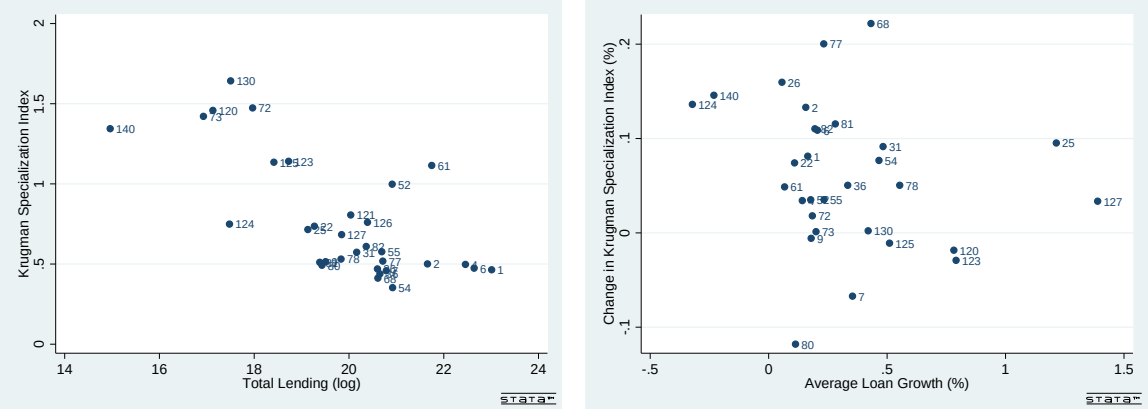
Source: SUNAT

Figure 3: Distribution of Bank Lending Shares by Country



Note: The boxes encompass the interquartile range of the distribution of S_{bct} (defined in equation 1) for each country c, in year 2010. The limits of the lines encompass 4 times the interquartile rage.

Figure 4: Bank Relative Concentration Index and Total Loans



(a) Krugman Index and Size (b) Krugman Index and Growth

Note: Bank Relative Concentration Index K_{bt} is defined in equation 2, period average by bank. Bank size is measured by its average total loans during the period. Bank growth is measured by its average annual change in total loans during the period. Banks are denoted by their code.

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 4, 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

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

Note: The statistics describe the distribution of the bank-country-time share S_{bct} (defined in equation 1) demeaned by the banking system's average $\overline{S}_{ct}$.

Table 3: Patterns of Bank Specialization

	N of countries in which bank is outlier for at least X% of the years			
	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 is specialized in country c during year t if it is an outlier in the distribution of loans across banks, for a given country-year, $O(S_{bct}) = 1$, according to definition 1.

Table 4: Index of Bank-Country Specialization

	$\mathcal{S}_{bc} = \overline{O(S_{bct})}$				
	Mean (1)	Std Dev (2)	Min (3)	Median (4)	Max (5)
Bank Code					
1	0.110	0.250	0.000	0.000	1.000
2	0.100	0.244	0.000	0.000	0.941
4	0.081	0.216	0.000	0.000	0.824
6	0.103	0.231	0.000	0.000	0.882
7	0.097	0.240	0.000	0.000	0.833
9	0.077	0.223	0.000	0.000	0.857
22	0.074	0.169	0.000	0.000	0.706
25	0.100	0.236	0.000	0.000	0.800
26	0.060	0.183	0.000	0.000	0.857
31	0.089	0.234	0.000	0.000	1.000
36	0.090	0.225	0.000	0.000	1.000
52	0.093	0.145	0.000	0.000	0.529
54	0.089	0.245	0.000	0.000	1.000
55	0.105	0.245	0.000	0.000	0.941
61	0.162	0.247	0.000	0.059	1.000
68	0.042	0.123	0.000	0.000	0.429
72	0.138	0.210	0.000	0.077	0.769
73	0.182	0.227	0.000	0.091	0.909
77	0.087	0.206	0.000	0.000	0.769
78	0.076	0.230	0.000	0.000	1.000
80	0.042	0.113	0.000	0.000	0.333
81	0.090	0.246	0.000	0.000	1.000
82	0.083	0.212	0.000	0.000	0.882
120	0.156	0.242	0.000	0.000	0.750
121	0.117	0.220	0.000	0.000	1.000
122	0.042	0.204	0.000	0.000	1.000
123	0.125	0.206	0.000	0.042	0.833
124	0.071	0.163	0.000	0.000	0.714
125	0.146	0.275	0.000	0.000	1.000
126	0.092	0.195	0.000	0.000	0.800
127	0.125	0.286	0.000	0.000	1.000
130	0.175	0.266	0.000	0.000	1.000
140	0.104	0.254	0.000	0.000	1.000

Note: $\mathcal{S}_{bc} = \overline{O(S_{bct})}$ is the proportion of years in which bank b was an outlier in the distribution of country c, as stated in equation 3. A bank b is specialized in country c during year t if it is an outlier in the distribution of loans across banks, for a given country-year, $O(S_{bct}) = 1$, according to definition 1.

Table 5: Characterization of the Index of Bank-Country Specialization

Dep. Variable	$\mathcal{S}_{bc}$			
	(1)	(2)	(3)	(4)
$\ln(Size_b)$	-0.00623			
	(0.00732)			
$ForeignBank_b$	0.00180			
	(0.01193)			
$\ln(X_c)$		0.13273***		
		(0.01369)		
$\ln(Size_b) \times \ln(X_c)$			0.02525***	
			(0.00741)	
$CountryOwnership_{bc}$				0.06767*
				(0.03785)
$CountrySubsidiary_{bc}$				0.00758
				(0.02430)
Bank-FE	No	Yes	Yes	Yes
Country-FE	Yes	No	Yes	Yes
Observations	792	792	792	792
R-squared	0.53980	0.21779	0.57085	0.56607

Note: $\mathcal{S}_{pc} = \overline{O(S_{bct})}$ is the proportion of years in which bank b was an outlier in the distribution of country c, as stated in equation 3. $\ln Size_b$ is (log) period-average bank's total outstanding credit (standardized) and $\ln X_c$ is (log) period-average total exports to country c (standardized). $ForeignBank_b$ is a dummy equal to 1 if bank's headquarters are outside Peru. $CountryOwnership_{bc}$ ($CountrySubsidiary_{bc}$) is a dummy equal to 1 if bank b is headquartered (has a subsidiary) in country c.

Table 6: Bank Relative Concentration Index

	K_{bt}				
	Mean (1)	Std. Dev (2)	Min (3)	Max (4)	N (5)
Overall	0.75	0.39	0.16	1.86	314
Between		0.37	0.35	1.64	33
Within		0.19	0.27	1.63	(T-bar = 9.81)
Bank Code					
1	0.46	0.13	0.20	0.72	17
2	0.50	0.19	0.25	0.90	17
4	0.50	0.13	0.30	0.71	17
6	0.47	0.15	0.16	0.71	17
7	0.46	0.12	0.34	0.63	6
9	0.51	0.13	0.34	0.68	7
22	0.74	0.18	0.51	1.14	17
25	0.72	0.21	0.50	0.98	5
26	0.47	0.13	0.24	0.63	7
31	0.57	0.09	0.48	0.75	7
36	0.44	0.13	0.29	0.62	6
52	1.00	0.41	0.56	1.68	17
54	0.35	0.08	0.25	0.49	7
55	0.58	0.14	0.37	0.86	17
61	1.11	0.24	0.78	1.66	17
68	0.41	0.12	0.23	0.57	7
72	1.47	0.24	0.99	1.83	13
73	1.42	0.16	1.18	1.65	11
77	0.52	0.20	0.16	0.84	13
78	0.53	0.07	0.43	0.65	6
80	0.49	0.07	0.41	0.54	3
81	0.51	0.14	0.31	0.70	6
82	0.61	0.19	0.32	0.95	17
120	1.46	0.26	1.20	1.78	4
121	0.81	0.37	0.51	1.69	10
123	1.14	0.27	0.87	1.86	12
124	0.75	0.29	0.40	1.19	7
125	1.13	0.12	0.93	1.29	8
126	0.76	0.20	0.61	1.11	5
127	0.68	0.04	0.65	0.72	4
130	1.64	0.09	1.50	1.71	5
140	1.34	0.13	1.25	1.44	2

Note: K_{bt} is defined in equation 2. The "between" statistics refer to the distribution of bank means. The "within" statistics refer to the distribution over time for a given bank, averaged across all banks. N refers to the number of bank-year pairs for the Overall, number of banks for the Between, and average number of banks' active years for the Within statistics. Number of observations per bank refers to the their number of years active.

Table 7: Bank Specialization and Comparative Advantage

Dep. Variable	$\ln(L_{ibt})$					
	$\mathcal{S}_b^c$ defined as		$\mathcal{S}_{bt}^c$ defined as		$\mathcal{S}_b^c = \hat{\mathcal{S}}_b^c$ defined as	
	$\overline{O(S_{bct})}$	$I[\overline{O(S_{bct})} > 0.5]$	$O(S_{bct})$	$O(\mathcal{P}_{bct})$	$\overline{O(\hat{S_{bct}})}$	$I[\overline{O(\hat{S_{bct}})} > 0.5]$
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln(X_{it}^c)$	0.02570***	0.02596***	0.02614***	0.02601***	0.02580***	0.02612***
	(0.00498)	(0.00450)	(0.00488)	(0.00479)	(0.00477)	(0.00456)
$\mathcal{S}_b^c \times \ln(X_{it}^c)$	0.01560***	0.01513***			0.01345***	0.01352***
	(0.00451)	(0.00331)			(0.00240)	(0.00292)
$\mathcal{S}_{bt}^c$			0.02044*	0.00200		
			(0.01225)	(0.01343)		
$\mathcal{S}_{bt}^c \times \ln(X_{it}^c)$			0.01226***	0.01215***		
			(0.00365)	(0.00234)		
Bank-Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	378,766	378,766	378,766	378,766	378,766	378,766
$R^2 adj$	0.325	0.325	0.325	0.325	0.325	0.325

Note: Results of specification 5, demeaned. $O(S_{bct})$, with S_{bct} defined in (1), is a dummy equal to 1 if bank b is an outlier in the corresponding country-year distribution; that is, if it is above the upper extreme value of the distribution, defined as the 75-th percentile plus 1.5 times the interquartile range. In column 1 (baseline regression), specialization is time-invariant; it is the fraction of years in which bank b was an outlier in the distribution of lending associated to country c, ($\mathcal{S}_b^c = \overline{O(S_{bct})}$). In column 2, $\mathcal{S}_{bct} = O(S_{bct})$ only counts banks as outlier that appear over half the length of the sample period. In column 3, $\mathcal{S}_{bct} = O(S_{bct}^i)$ equals 1 if bank b is an outlier in in country c in year t. In column 4, $\mathcal{S}_{bct} = O(\mathcal{P}_{bct})$ equals 1 if $\mathcal{P}_{bct}$ defined as in (6) is an outlier. Standard errors are clustered at the bank level. ***p$<$ 0.01, **p $<$ 0.05, and *p $<$ 0.1.

Table 8: Comparative Advantages and Bank Size

Dep. Variable	$\ln(L_{ibt})$		
	(1)	(2)	(3)
$\ln(X_{it}^c)$	0.02916***	0.01144***	0.01370***
	(0.00578)	(0.00324)	(0.00340)
$\mathcal{S}_b^c \times \ln(X_{it}^c)$	0.01990***	0.01384***	0.01150***
	(0.00640)	(0.00391)	(0.00426)
$\ln(X_{it}^c) \times Small_b$	-0.01533		
	(0.01370)		
$\mathcal{S}_b^c \times \ln(X_{it}^c) \times Small_b$	-0.04740**		
	(0.02029)		
$Merger_{bt}$			-0.04516*
			(0.02309)
$\ln(X_{it}^c) \times Merger_{bt}$			-0.02387***
			(0.00868)
$\mathcal{S}_b^c \times Merger_{bt}$			0.04508***
			(0.01489)
$\mathcal{S}_b^c \times \ln(X_{it}^c) \times Merger_{bt}$			0.02264*
			(0.01348)
Firm-year FE	Yes	–	–
Bank-year FE	Yes	–	–
Country-bank FE	Yes	–	–
Firm-Merger-year FE	–	Yes	Yes
Bank-Merger-year FE	–	Yes	Yes
Country-bank-Merger FE	–	Yes	Yes
Observations	378,766	604,861	604,861
R^2adj	0.324	0.302	0.302

Note: In column 1, results of specification 5 (demeaned) augmented with an interaction $Small_{bt}$, a dummy equal to 1 for banks smaller (measured in total outstanding credit) than the one at the median observation at time t. The index of bank-country specialization, $\mathcal{S}_b^c$, is defined in (3). In columns 2 and 3 data are rearranged around event time (Merger) and the index of bank-country specialization is the outlier variable in definition 1, $\mathcal{S}_b^c \equiv O(S_{bct})$, computed the year before the merger. The results in column 2 correspond to specification 5 (demeaned). In column 3, the specification is augmented with the interacting term $Merger_{bt}$, a post-merger dummy. Standard errors are clustered at the bank level. ***p$<$ 0.01, **p $<$ 0.05, and *p $<$ 0.1.

Table 9: Comparative Advantages and Country of Ownership

Dep. Variable	$\ln(L_{ibt})$	
	(1)	(2)
$\ln(X_{it}^c)$	0.02622***	0.09395
	(0.00464)	(0.06379)
$\mathcal{S}_b^c \times \ln(X_{it}^c)$	0.01560***	0.01848**
	(0.00482)	(0.00871)
$CountryOwnership_b^c \times \ln(X_{it}^c)$	-0.01949	-0.03773
	(0.02196)	(0.03362)
$ln(DistancetoHeadquarters_b^c) \times \ln(X_{it}^c)$		-0.00796
		(0.00728)
$CommonLanguage_b^c \times \ln(X_{it}^c)$		-0.00518
		(0.01135)
$ExColony_b^c \times \ln(X_{it}^c)$		0.01527
		(0.01519)
$CountrySubsidiary_b^c \times \ln(X_{it}^c)$		0.01154
		(0.01190)
Firm-year FE	Yes	Yes
Bank-year FE	Yes	Yes
Country-Bank FE	Yes	Yes
Observations	378,766	378,766
R^2adj	0.325	0.325

Note: In column 1 results of specification 5 (demeaned) are augmented with an interaction term $CountryOwnership_{bc}$, a dummy equal to 1 if the destination country of the export flow coincides with the country of ownership of the bank. In column 2, the specification is further augmented with distance, common language, and former-colony relationship between the bank's country of ownership and the export destination. The index of bank-country specialization, $\mathcal{S}_b^c$, is defined in (3). Standard errors are clustered at the bank level. ***p$<$ 0.01, **p $<$ 0.05, and *p $<$ 0.1.

Table 10: Instrumental Variable Estimates: Export Shocks

	OLS	First Stage		IV
Dep. Variable	$ln(X_{it}^c)$	$\ln(X_{it}^c)$	$\mathcal{S}_b^c \times \ln(X_{it}^c)$	$\ln(L_{ibt})$
	(1)	(2)	(3)	(4)
$GDPGrowth_t^c$	0.01036***	0.01302***	-0.00051	
	(0.00287)	(0.00122)	(0.00043)	
$\ln(RER_t^c)$	0.50363***	0.48411***	-0.01752***	
	(0.02810)	(0.01430)	(0.00500)	
$\mathcal{S}_b^c \times GDPGrowth_t^c$		0.04396***	0.04575***	
		(0.00493)	(0.00172)	
$\mathcal{S}_b^c \times \ln(RER_t^c)$		3.51673***	4.85571***	
		(0.11472)	(0.04011)	
$\ln(X_{it}^c)$				0.33918**
				(0.17304)
$\mathcal{S}_b^c \times \ln(X_{it}^c)$				0.11970**
				(0.05935)
Firm-Year FE	Yes	Yes	Yes	Yes
Bank-Year FE	Yes	Yes	Yes	Yes
Bank-Country FE	Yes	No	No	No
Observations	346,131	346,131	346,131	346,127

Note: Specification (5). Exports to country c at time t are instrumented with the country's GDP growth and bilateral real exchange rate (an increase corresponds to country c's appreciation). $\mathcal{S}_b^c = \overline{O(S_{bct})}$ is the fraction of years in which bank b was an outlier in the distribution of loans associated to country c (see definition in equation 3). Standard errors are clustered at the bank level. ***p< 0.01, **p $<$ 0.05, and *p $<$ 0.1.

APPENDIX

A.1 The Model

This appendix presents a simple partial equilibrium model that 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 comparative advantages. Without explicitly defining the market structure for the firms' output nor the sources of banks' comparative advantages, our goal is to present a 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:

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

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.

If $\rho = \infty$ all sources of credit are perfect substitutable, in which case the funding of activity j depends on the overall funding of firm i allocated to activity j, without differentiating the lending institution:

$$q_{ij} = \sum_{b=1}^{B} L_{ib}^{j}$$

The optimal borrowing of firm i from each bank b solves the following cost-minimization problem:

$$\min_{\{L_{ib}^{j}\}_{j,b}} \sum_{b=1}^{B} r_b \, L_{ib} \quad s.t. \quad q_{ji}\left(\{L_{ib}^{j}\}_{b=1}^{B}\right) = \overline{q}_{ji} \quad \forall j \in J_i \tag{A.2}$$

$$L_{ib} = \sum_{j \in J_i} L_{ib}^{j} \quad \forall b \tag{A.3}$$

where $q_{ji}\left(\{L_{ib}^{j}\}_{b=1}^{B}\right)$ is defined in equation A.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 constraint (A.2), which is the marginal cost of producing q_{ij}. We

use the transformation of marginal cost, λ_{ij}, to translate quantities q_{ij} representing the different activities into monetary values and denote $X_{ij} \equiv \lambda_{ij} q_{ij}$.[14] Then, the overall debt of firm i with bank b can be expressed as:

$$L_{ib} = \left(\frac{1}{r_b}\right)^{\rho} \sum_{j \in J_i} X_{ji}\, \gamma_{jb} \tag{A.4}$$

We consider each bank b to be characterized by the price of lending r_b and a vector of activity-specific productivity $\gamma_b = [\gamma_{1b}, ..., \gamma_{Jb}]$. The productivity parameter can be interpreted as an activity-specific monitoring advantage 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.

If sources of credit are perfect substitutes (i.e. $\rho = \infty$), the demand of credit only depends on the price charged by each bank, r_b. If this is the case, firms only borrow from the bank that offers funding at the lowest price. On the other hand, if sources of credit are not perfect substitutes (i.e. $0 < \rho < \infty$), 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.

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 A.4.

Result 1. *Everything else equal, firms that specialize in activity j borrow more from banks with comparative advantage in activity j. That is, if $X_{ij} > X_{ij'}$ then $L_{ib} > L_{ib'}$ for $r_b = r'_b$.*

Result 2. *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, $S_{bj} > S_{b'j}$.[15]

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

$$S_{bj} + S_{bj'} = S_{b'j} + S_{b'j}$$

Then,

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

[14] 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.

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

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 $\gamma_{bj} = \gamma_{b'j'} > \gamma_{bj'} = \gamma_{b'j}$. □

Result 3. *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}.*

Table 1: Appendix - Distribution of Bank Lending Shares by Product

	$S_{bct} - \overline{S}_{ct}$				
	Std. Dev. (1)	Min (2)	Median (3)	Max (4)	Skewness (5)
Live animals, animal products	0.0893	-0.0812	-0.0047	0.9049	8.03
Vegetable products	0.1708	-0.1514	-0.0324	0.9334	4.11
Animals or vegetable fats and oils, prepared foodstuffs	0.2542	-0.5065	-0.0694	0.6581	0.64
Mineral products	0.2321	-0.3496	-0.0567	0.7966	0.92
Products of the chemical or allied industries	0.0274	-0.0329	-0.0058	0.1988	4.71
Plastics, rubber and articles thereof	0.0546	-0.0623	-0.0021	0.7496	9.61
Raw hides and skins, leather, furskins and articles thereof	0.0671	-0.0609	-0.0002	0.8439	11.11
Wood and articles of wood, pulp of wood	0.0732	-0.0565	-0.0034	0.9560	9.15
Textile and textile articles	0.1698	-0.1555	-0.0505	0.8695	3.17
Footwear, hats, wigs, articles made of stone, ceramics	0.1484	-0.1453	-0.0325	0.8592	3.25
Base metals and articles thereof	0.1347	-0.1889	-0.0383	0.8110	1.78
Machineries, electrical machinery and equipment	0.1117	-0.0742	-0.0058	0.9494	6.25
Vehicles, aircraft, vessels and associated transport equipment	0.0599	-0.0603	-0.0010	0.9008	11.84
Optical, photographic instruments, watches, musical instruments	0.0066	-0.0076	-0.0001	0.1093	14.61
Arms and ammunition, miscellaneous manufactured articles, works of art	0.0500	-0.0550	-0.0018	0.7892	12.83
Overall	0.1306	-0.5065	-0.0036	0.9560	2.98

Note: The statistics describe the distribution of the bank-product-time share S_{bpt} (defined in equation 1 but classifying exports by broad product categories instead of destination markets) demeaned by the banking system's average $\overline{S}_{pt}$.

Table 2: Appendix - Patterns of Bank Specialization (by Product)

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

Note: Bank b is specialized in product p during year t if it is an outlier in the distribution of loans across banks, for a given product-year, $O(S_{bpt}) = 1$, according to definition 1.

Table 3: Appendix - Index of Bank-Product Specialization

	$\mathcal{S}_{bc} = \overline{O(S_{bct})}$				
	Mean (1)	Std Dev (2)	Min (3)	Median (4)	Max (5)
Bank Code					
1	0.125	0.233	0.000	0.000	0.706
2	0.106	0.239	0.000	0.000	0.765
4	0.137	0.282	0.000	0.000	0.882
6	0.145	0.291	0.000	0.000	0.941
7	0.156	0.299	0.000	0.000	1.000
9	0.095	0.227	0.000	0.000	0.714
22	0.129	0.264	0.000	0.059	0.882
25	0.093	0.183	0.000	0.000	0.600
26	0.133	0.283	0.000	0.000	0.857
31	0.171	0.292	0.000	0.000	0.857
36	0.067	0.138	0.000	0.000	0.500
52	0.102	0.187	0.000	0.000	0.529
54	0.133	0.326	0.000	0.000	1.000
55	0.102	0.257	0.000	0.000	1.000
61	0.169	0.214	0.000	0.118	0.765
68	0.076	0.222	0.000	0.000	0.857
72	0.118	0.195	0.000	0.000	0.615
73	0.176	0.180	0.000	0.182	0.545
77	0.118	0.273	0.000	0.000	1.000
78	0.111	0.265	0.000	0.000	1.000
80	0.178	0.353	0.000	0.000	1.000
81	0.144	0.281	0.000	0.000	1.000
82	0.125	0.285	0.000	0.000	1.000
120	0.167	0.309	0.000	0.000	0.750
121	0.107	0.209	0.000	0.000	0.600
122	0.067	0.258	0.000	0.000	1.000
123	0.111	0.177	0.000	0.000	0.583
124	0.133	0.244	0.000	0.000	0.857
125	0.175	0.327	0.000	0.000	1.000
126	0.093	0.183	0.000	0.000	0.600
127	0.100	0.264	0.000	0.000	1.000
130	0.173	0.281	0.000	0.000	0.800
140	0.167	0.309	0.000	0.000	1.000

Note: $\mathcal{S}_{bp} = \overline{O(S_{bpt})}$ is the proportion of years in which bank b was an outlier in the distribution of product p, as stated in equation 3. A bank b is specialized in product p during year t if it is an outlier in the distribution of loans across banks, for a given product-year, $O(S_{bpt}) = 1$, according to definition 1.