The Information Content from Lending Relationships Across the Supply Chain

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Abstract

We investigate whether bank relationships across firms connected through product market ties affect the supply of loans to these firms. We show that the supply of loans to a firm increases by 25% when the firm's suppliers or customers have loans from the same bank. We also show that when a bank receives negative information about the creditworthiness of a firm's suppliers or customers, it reduces the loan amount supplied, increases the cost, and reduces the duration of loans to the firm. These results suggest that lending to firms connected through the supply chain conveys valuable information to banks.

Keywords: bank relationship, cross-client lending, supply chain, network spillovers.

JEL Codes: G21, E50, E59, E24.

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1. Introduction

Business ties are an important driver of firms' financial performance. A bank may extract useful information about a borrowing firm by learning about the firm's customers and suppliers. Several recent studies investigate the interplay between a firm's business ties and the credit market. Valta (2012) and Campello and Gao (2017) study how competition in the product market affects firms' cost of debt and loan terms. Another stream of literature investigates how interfirm relationships affect business performance (Cai and Szeidl, 2018; Cohen and Frazzini, 2008) and the firm's capital structure (Banerjee et al., 2008). A recent strand of literature studies how shocks to a bank propagate through the supply chain and to the employees of the bank's borrowers (Alfaro et al., 2021; Huremovic et al. 2020; Cortes et al., 2020).

In this paper, we investigate how a bank's relationships with a firm's customers and suppliers affect lending to the firm. We also study how idiosyncratic credit deterioration information about a given firm (a loan falling into arrears) affects the supply of loans to other firms along its supply chain. To identify the firms' commercial counterparties (i.e., their customers and suppliers), we use a unique dataset that maps the network of the real economy in Brazil by tracking money transfers, allowing us to identify each firm's suppliers and customers. We merge this dataset with credit bureau data that contain detailed loan-level information on bank-to-firm loans. Hence, our data allow us to use information on lending at the bank-firm level, while at the same time identifying bank lending to each firm's customers and suppliers in a novel way. To the best of our knowledge, this

is the first paper to address bank relationships at the supply chain level. We analyze how the supply of loans to a given firm is affected by the bank relationships of the firm's commercial counterparties and how changes in a firm's creditworthiness affect the supply of loans (and loan terms) to its suppliers and customers.

Lending to a firm's customers and suppliers enhances a bank´s information set about the firm. However, lending to multiple firms that are linked by commercial ties also increases the concentration risk of the bank's loan portfolio by means of cross-client contagion and increased cash flow risk (BIS, 1999). Because of business ties, idiosyncratic negative shocks to a borrower may propagate to its entire economic network. Hence, bank lending to multiple firms across the same supply chain increases the bank's exposure to such shocks (Croci et al., 2021; Kolay et al., 2016; Hertzel et al., 2008).

To date, the literature that investigates how banks assess the loan exposure that stems from their borrowers´ business ties is scarce. Alfaro et al. (2021) and Huremovic et al. (2020) provide evidence on the real effects of credit supply shocks which originate in the financial sector and propagate through customers (downstream) and suppliers (upstream); Campello and Gao (2017) and Hasan (2020) show that loan terms are associated with customer concentration; Rahaman et al. (2020) argue that supply chain power is relevant to bank financing.

However, little is known about the information content that banks acquire by engaging in multiple relationships with firms that are connected through the supply chain and the effects of an unexpected (idiosyncratic) shock to a given firm in terms of the supply of loans to its commercial counterparties.

We start by documenting that bank relationships across the supply chain are relevant at both the extensive and intensive margins. A bank lends more to a firm if it also lends to the firm's suppliers and customers, and the intensity of the relationship of the suppliers and customers of a firm with a given bank is relevant in terms of explaining the firm's own financing from the same bank. Borrowers whose suppliers have any loans from a given bank receive an incremental 14.9% in loans from that same bank. At the intensive margin, doubling the size of the loan portfolio of the firm's suppliers with a bank translates into an additional 1.3% in the borrower's amount of loans from that bank. Similarly, when a firms' customers have loans with a bank, we observe an additional 15.6% in loans from that bank to the same firm. Moreover, doubling the size of the customers' loan portfolio with a bank increases lending from the same bank to the firm by 1.5%. For the median firm, having a common lending bank with its commercial counterparties adds up between 23.7% and 24.5% to the firm's own borrowing from that common bank.

We follow our analysis by investigating how banks adjust the supply of loans to a firm when they receive signs of credit deterioration about one of the firm's main commercial counterparties. More specifically, we perform a differences-in-differences analysis to investigate how the loan terms provided by a bank to a

firm change when the top supplier or customer of the firm has a loan that falls into arrears with that bank. The bank that receives this negative information about the firm's main supplier reacts by reducing the amount of loans provided to the firm by 7.7% compared to other banks. This bank also decreases the duration of loans to the firm by 5.6% and increases the interest rate by 8.2 percentage points (pp) in comparison to other banks. Similarly, there is an 8.5% reduction in the duration of loans and a 4.9 pp increase in interest rates upon a loan of the firm's main customer falling into arrears with the same bank.

Our inferences are robust to bank-specific variations in loan supply over time and firm-specific variations in loan demand over time (including firm size and other observable changes in creditworthiness), as we use bank-time and firm-time fixed effects in all our estimations. In other words, our estimates look at within-firm variation in bank lending, depending on the relationship of different banks with the firm's customers and suppliers while controlling for the heterogeneity in bank loan supply over time. We also deploy robustness checks to address concerns about banks' and firms' geographical location, sector specificity and risk profile.

We add to the literature on relationship banking by looking at how banks produce information from lending to multiple borrowers that are connected through business ties. Most of the literature to date has looked at how the intensity and length of a bank-firm lending relationship affect loan terms and analyzed the role of competition and the tradeoffs of single versus multiple bank relationships (e.g., Petersen and Rajan, 1994; Berger and Udell, 1995; von

Thadden, 1995; Boot and Thakor, 2002; Degryse and Van Cayseele, 2000; Elyasiani, 2004; Agarwal and Hauswald, 2010; Bolton et al., 2016; Beck et al., 2018, among others). Another stream of literature focuses on how bank relationships across different financial services (but with the same borrower) affect contracting terms (e.g., Puri, 1996, 1999; Drucker and Puri, 2005; Mester et al., 2007; Norden and Weber, 2010; Puri et al., 2017). A third stream looks at the role of bank relationships in facilitating firms' access to new product markets, such as exports (Bronzini and D'Ignazio, 2017).

We innovate by widening the notion of bank relationships from narrow bank-firm lending *per se* to a broader concept of lending across the supply chain, i.e., to a borrower's suppliers and customers. Our paper also adds to Huremovic et al.'s (2020) findings in that they document how shocks to a bank spill over to the customers and suppliers of the bank's borrowing firms, whereas we document how idiosyncratic shocks to a given firm affect the supply of loans to the firm's commercial counterparties.[4] More indirectly, our paper also relates to the literature that investigates the role of bank relationships for firms in financial distress (e.g., Dahiya et al., 2003) in that we study the effects of idiosyncratic negative information about a firm on the supply of loans to its commercial counterparties.

[4] Our empirical approach is conceptually close to Khwaja et al. (2011), but it is different on two major features: first, our notion of network formation stems from business ties in the product market (customers and suppliers), not from common board participants. Second, our identification strategy is underpinned by bank-time and firm-time fixed effects, as well as the spillover effects from the deterioration in credit quality among supplier or customers.

Our results are important to regulators, as they show that negative shocks to firms (even if idiosyncratic) may have detrimental effects on the loan portfolio of banks that go beyond loans to that specific borrower. This may be particularly important when these idiosyncratic shocks happen to large firms, which are customers and suppliers to many other firms that have loans with the same bank. On the other hand, our results show that banks quickly adjust their loan supply downward by reducing loan amount, increasing interest rates and decreasing loan duration upon signs of contagion along the supply chain. Finally, these results also have implications for information sharing initiatives ("open banking"). They show that banks benefit from gathering private information not only about the borrowing firm itself (which could be shared through open banking initiatives) but also from information that cannot be shared via open banking (in our case, information about the creditworthiness of the firm's commercial counterparties), meaning that relationship lending is still valuable to banks, even with information sharing mechanisms in place.

The remainder of this paper is structured as follows. Section 2 presents our hypothesis development. Section 3 describes our data gathering setup and descriptive statistics. Section 4 provides the empirical identification strategy, and Section 5 concludes.

2. Hypotheses Development

Agency costs and information asymmetries may induce banks to ration credit (Stiglitz and Weiss, 1981). The unique characteristics of banks in monitoring

debtors can induce market discipline (Diamond 1984, Holmstrom and Tirole 1997) and help reduce market frictions (Becket al., 2007). The relationship banking literature has shown that banks benefit from their information monopoly and can still provide funds to opaque and risky firms (Petersen and Rajan 1994, Freixas and Rochet 2008).

Our aim with this paper is to present a known – but previously undocumented – channel by which banks enhance their screening and monitoring processes. When a bank lends to a firm and, at the same time, to the firm's customers and suppliers, it learns from these cross-borrower relationships and improves the information set used for selecting applicants, pricing loans and monitoring portfolio risks. This is an analogous version to Petersen and Rajan's (1994) argument: while their work is underpinned by the relationship between the borrower and the bank over time, ours is based on a cross-sectional information set that stems from the borrower's business ties.

Our conjecture is that banks use this cross-client information to achieve a more comprehensive credit assessment of the borrower. Hence, our hypothesis is:

> **H1.** The amount of loans granted by a bank to a firm is positively related to the existence of a lending relationship between the bank and the firms' commercial counterparties.

By the same token, we argue that the information content of cross-client lending allows banks to re-estimate credit risks and to adjust the granted loan amount and lending terms of firms' commercial counterparties based on new information

coming from these cross-client relationships. We expect that when a bank receives negative information about a firm's creditworthiness (such as a loan falling into arrears), it will respond by tightening the loan terms of other firms in the same supply chain. Therefore, our second hypothesis is:

> **H2.** The amount of loans granted by a bank to a firm is reduced when a loan of one of its important commercial counterparties falls into arrears in the same bank.

Finally, we also formulate hypotheses that are analogous to H2, claiming that the bank increases the interest rate charged on loans and reduces loan duration of a firm upon a commercial counterparty falling into arrears.

3. Data and Descriptive Statistics

To understand the implications of lending across the supply chain, we merge two unique datasets. The first dataset is built from the *Banco Central do Brasil* credit bureau (Bustos et al. 2020, Ponticelli and Alencar 2016, among others, use the same dataset). The bureau data contain loan-level information for all borrowers whose credit exposure with a given bank is above 200 Brazilian reais (approximately 40 USD, as of September 2020) in any month. Our sample encompasses loans from commercial and multiple banks, following most of the literature. These types of intermediaries are responsible for approximately 80% of lending in the Brazilian banking system, as of September 2020. We exclude cooperative banks, development banks and nonbanking institutions because

their credit granting processes are typically different from those of commercial banks.

We restrict our sample to firms with outstanding credit amounting to at least 1 million Brazilian reais (approximately 200 thousand US dollars) in the Brazilian banking system in any month between March 2017 and September 2020, including actual loans *and* any other type of contingent exposure (e.g., lines of credit).[5] The rationale for restricting our sample is that credit risk assessment for this group of (larger) firms is more subject to upstream and downstream network analysis by the lender, whereas the credit assessment process for smaller firms is retail-style, with own-firm idiosyncrasies playing a major role.[6] The loans to firms in our sample amount to BRL 1.13 trillion, or 67% of the overall loans provided by banks to nonfinancial firms in Brazil, as of September 2020. Based on this information, we build a quarterly measure of the loan outstanding amount at the bank-to-firm level for every firm in our sample in every quarter between March 2017 and September 2020.[7]

The second dataset also comes from the *Banco Central do Brasil* and contains information on interfirm payments. More specifically, it covers all money transfers between accounts in different banks ("TED", for its acronym in

[5] We use a broader definition of outstanding credit, including lines of credit and other contingent exposures, to mitigate selection bias. Had we not considered these types of exposure, we might have excluded creditworthy firms that use little bank debt.

[6] Table A.6 at the Online Appendix shows that this assumption is consistent with our empirical results: the effect of cross-client exposure on loan granting becomes more relevant as we restrict the sample to even larger firms.

[7] The first 4 quarters (i.e., 2017 data) of credit data is used only to acquire information on lagged independent variables, while 2018 onward will be the core of our analysis.

Portuguese [8]) and "*boletos*" (which are a form of payment bill that accompanies invoices), which run through the Brazilian Payments System (SPB, the acronym in Portuguese) in 2019. In contrast to credit bureau data, only recently have SPB data been used by scholars (Correia et al. 2020, Cortes and Van Doornik 2019) and by the Central Bank in contagion exercises (BCB 2015; 2020). Most customer-to-supplier payments in Brazil are made using either TEDs or *boletos*. This information allows us to identify the receiver and the payer, as well as the amount paid, for every single direct money transfer and *boleto*. Although we cannot identify other types of money transfers – particularly same-bank book transfers – we rely on SPB data to build the network of customers and suppliers in the real economy. [9]

Therefore, for each firm that makes or receives payments in our sample, it is possible to observe its full set of suppliers and customers, as well as the value of interfirm payments. In our dataset, there are 3.28 million unique firms that received payments and 3.48 million firms that made payments. These payments add up to BRL 3.96 trillion (money transfers) and BRL 3.46 trillion (*boletos*), which correspond to 54% and 48% of Brazil´s GDP, respectively, as of 2019. In our database, there are 9.5 million pairs of firms transferring money through

[8] TED (*Transferência Eletrônica Disponível*) is a form of interfirm money transfer between different banks that enables the transfer to be done within a 30-minute limit.

[9] Since 2016, the Central Bank of Brazil (BCB) has been performing a supervisory contagion routine on the credit portfolio of the Brazilian Financial System, mapping the network of payments in the real economy (BCB, 2015). In the beginning, this was done by analyzing only direct money transfers (TEDs) through the Brazilian Payment System, to and from companies and their relevant importance to the companies´ revenues (IMF 2018). Starting in 2019, the BCB improved its measure by adding the "*boletos*" (payment bills). Accordingly, we use 2019 data to build our supplier-customer network.

"TEDs" and 23.2 million pairs using *boletos*. The mean (median) money transfer is BRL 417 thousand (BRL 39 thousand), while the mean (median) *boleto* is BRL 149 thousand (BRL 26 thousand).[10]

By merging these two datasets, we can build several measures of bank relationships within the supplier-customer network. For example, we can build bank-firm-quarter measures constituting the overall amount of loans provided by a bank to the suppliers and to the customers of a given firm in each period. Overall, our sample comprises a total of 136,777 firms, 131 banks and 3.57 million bank-firm-quarter observations of bank-to-firm loans.[11]

Table 1 shows the descriptive statistics for the main variables of the "raw" sample data. The variable in the first row of Table 1 is the outstanding loan amount at the bank-firm-quarter level (i.e., the loan amount provided by bank *b* to firm *i* in quarter *t*). Panel A shows that the median (average) borrower has an outstanding loan amount of BRL 0.24 million (BRL 3.03 million) from a given bank. We note that the outstanding loan amount is smaller than the threshold of 1 million BRL that we use to select our sample for approximately 78% of our observations for three reasons. First, to be included in the sample, we require the firm to have reached the 1 million BRL threshold in *any* quarter during our sample period,

[10] Brazil has approximately 20 million active firms, but only 2 million of them have any form of bank debt. The average exchange rate in 2019 was 3.95 BRL/USD.

[11] A firm is defined in our sample by its national 8-digit registry code ("CNPJ – Cadastro Nacional de Pessoa Jurídica"). Consistent with the previous literature using US data (Gatev and Strahan, 2006) and Brazilian data (e.g., Oliveira et al., 2015), we use information at the bank holding company-level (bank conglomerate code), to consider loan granting as a unique process within the conglomerate. The number of firms in the merged dataset is substantially smaller than in the payments data because of the exclusion of firms with less than BRL 1 million in outstanding credit in any quarter.

which means that, in a given quarter, the firm may have a smaller amount of outstanding loans. Second, our inclusion criteria refer to the sum of loans with all banks being larger than 1 million BRL, whereas the measure reported in Table 1 is the outstanding loan amount with a single bank. Third, the BRL 1 million selection threshold used for sample selection takes loans, credit lines and other types of contingent credit exposure into consideration, whereas our measure of outstanding loans in Table 1 includes only *actual* loans taken by the firms.

The variables described in the second and third rows in Panel A of Table 1 are also at the bank-firm-quarter level and measure the outstanding loans of all suppliers and customers of a given firm at the bank in each quarter, respectively. Out of the 3.57 million firm-bank-quarter observations, 1.49 million (1.15 million) of them have *at least one* of the suppliers (customers) borrowing from the same bank in the same quarter.[12]

In the subsequent rows of Panel A of Table 1, we dissect the previous variable by discriminating the amount of loans outstanding for each of the five most relevant suppliers and customers of the firm. Comparing the loan amount at the same bank, the main suppliers, when tracked, are larger than the typical firm in our sample. While the loans outstanding for the median firm are BRL 0.24 million, the median Top1 Supplier (Top 1 Customer) has outstanding loans of BRL 2.80 million (BRL 2.72 million) with the same bank (fourth and ninth rows of Table 1,

[12] This possibly occurs because many firms (i) do not transfer money at all; (ii) transfer money but their commercial counterparties do not have debt in their balance sheet; or alternatively (iii) they only have debt in other banks; (iv) and, to a lesser extent, their suppliers or customers do not have outstanding loans that amount to BRL 1 million anytime during our sample period.

Panel A). This occurs because large firms are more likely to be the main supplier or main customers for a given firm than small firms are (we will return to this point later, in Section 3). As we move to the second through fifth most important suppliers and customers, their mean and median loan outstanding amounts with the same bank monotonically decrease, hence, suggesting that larger firms are more likely to be the main customers and suppliers for a firm in our sample.

On Panel B of Table 1, we show that, conditional on having at least one supplier that borrows from the same bank, the average number of suppliers with loans at the same bank is 12. The analogous value for customers is 15.

The data described in Panel C of Table 1 show that, irrespective of whether the supplier and customer have outstanding loans at the same bank as the firm, we can detect at least one supplier (customer) in 1.90 million (1.86 million) observations or just over half of our observations. We conjecture that this is primarily due to the lack of intrabank money transfer data in our setting (which happens when a customer pays a supplier by transferring money between their respective accounts in the same bank, a piece of information that is not included in our data). Finally, for those firms whose main supplier was detected, the main supplier accounts for 25% of the firms' payments on average. Using the same analogy, the main customer of the average firm responds for 22% of the total payments received by the firm (conditional on having the main customer detected).

We also note that the ratio between money transfers and the portfolio of loans is sizeable. The money transfers made by the average firm are equivalent to 19% of the same-bank outstanding loan amount of its suppliers, whereas the transfers received by the average firm from its customers equal 22% of the same-bank outstanding loan amount of the firm's customers. While on average, suppliers received BRL 77.62 million in 2019, their customers had an average outstanding loan amount of BRL 415.26 million with the same bank. The average customer transfers BRL 108.43 million to firms that borrow an average of BRL 484.94 million.

To address the large number of missing observations, we create, for each firm-bank-quarter observation, a dummy variable, *Dummy(All Suppliers)*, that has a value of 1 whenever the web of suppliers is traceable *and* at least one of the firm's suppliers has outstanding loans with same bank, and is 0 otherwise. An analogous dummy variable is created for customers, *Dummy(All Customers)*. To mitigate the effect of outliers, we winsorize all continuous variables at the 1st and 99th percentiles. Using these procedures, Panels D, E, F and G of Table 1 describe the data that we use as input in our econometric models.

Table 1 - Descriptive Statistics

Panel A/B/C - Raw data

The descriptive statistics below show the figures of each variable "as is": missing observations are *not* assigned to zero values.

	Unit	Mean	p25	p50	p75	sd	Observations
Panel A: Loan amounts							
Borrower Loans	BRL Million	3.03	0.04	0.24	0.84	61.30	3,573,632
All Suppliers	BRL Million	415.26	4.35	41.00	286.71	1128.51	1,494,708
All Customers	BRL Million	484.94	1.51	19.71	176.54	1945.19	1,151,060
Top 1 Supplier	BRL Million	150.69	0.28	2.80	34.54	703.80	348,224
Top 2 Supplier	BRL Million	105.10	0.23	2.28	22.74	498.55	300,255
Top 3 Supplier	BRL Million	89.72	0.21	2.04	18.12	425.17	273,927
Top 4 Supplier	BRL Million	85.48	0.21	1.93	16.13	479.20	260,695
Top 5 Supplier	BRL Million	71.74	0.19	1.81	14.46	401.35	244,857
Top 1 Customer	BRL Million	197.93	0.23	2.72	29.58	1142.14	238,557
Top 2 Customer	BRL Million	136.47	0.20	2.14	21.63	872.17	234,861
Top 3 Customer	BRL Million	115.04	0.18	1.85	17.95	820.76	214,873
Top 4 Customer	BRL Million	103.98	0.18	1.79	15.60	793.81	197,698
Top 5 Customer	BRL Million	102.41	0.17	1.72	15.28	778.65	185,319
Panel B: Number of business relationships							
Number of Suppliers	Un.	12.13	2.00	5.00	12.00	25.10	1,494,708
Number of Customers	Un.	15.75	1.00	4.00	11.00	59.81	1,151,060
Panel C: Transaction amounts (transfers in 2019)							
Top 1 Supplier	BRL Million	19.36	0.30	0.98	3.95	628.56	1,899,010
Top 2 Supplier	BRL Million	5.82	0.15	0.45	1.60	65.20	1,868,398
Top 3 Supplier	BRL Million	3.83	0.10	0.30	1.05	46.03	1,839,273
Top 4 Supplier	BRL Million	2.83	0.08	0.23	0.80	25.30	1,808,698
Top 5 Supplier	BRL Million	2.36	0.07	0.19	0.65	22.86	1,777,468
Other Suppliers (ex Top1-Top5)	BRL Million	46.92	0.38	1.62	7.64	579.20	1,777,468
All Suppliers	BRL Million	77.62	1.19	4.23	16.43	1100.10	1,899,010
Top 1 Customer	BRL Million	23.62	0.41	1.43	5.44	785.76	1,863,049
Top 2 Customer	BRL Million	11.15	0.16	0.54	2.11	489.43	1,775,070
Top 3 Customer	BRL Million	8.51	0.10	0.34	1.31	448.90	1,681,258
Top 4 Customer	BRL Million	6.11	0.08	0.25	0.97	295.11	1,593,574
Top 5 Customer	BRL Million	4.02	0.07	0.21	0.80	136.10	1,515,283
Other Customers (ex Top1-Top5)	BRL Million	71.33	0.23	1.47	8.55	1684.56	1,515,283
All Customers	BRL Million	108.43	1.16	4.39	18.70	3461.33	1,863,049

Table 1 - Descriptive Statistics (cont.)

Panel D/E/F/G - Winsorized and Missing value assigned to zero
The descriptive statistics below show the figures of each variable assigned zero values when missing, and after winsorization at 1%.

	Unit	Mean	p25	p50	p75	sd	Observations
Panel D: Loan amounts							
Borrower Loans	BRL Million	1.53	0.04	0.24	0.84	4.87	3,573,632
All Suppliers	BRL Million	160.93	0.00	0.00	19.27	585.66	3,573,632
All Customers	BRL Million	136.51	0.00	0.00	1.10	788.37	3,573,632
Top 1 Supplier	BRL Million	12.55	0.00	0.00	0.00	137.50	3,573,632
Top 2 Supplier	BRL Million	7.72	0.00	0.00	0.00	99.86	3,573,632
Top 3 Supplier	BRL Million	6.07	0.00	0.00	0.00	85.09	3,573,632
Top 4 Supplier	BRL Million	5.12	0.00	0.00	0.00	75.13	3,573,632
Top 5 Supplier	BRL Million	3.93	0.00	0.00	0.00	58.60	3,573,632
Top 1 Customer	BRL Million	9.73	0.00	0.00	0.00	157.16	3,573,632
Top 2 Customer	BRL Million	6.16	0.00	0.00	0.00	94.53	3,573,632
Top 3 Customer	BRL Million	4.36	0.00	0.00	0.00	70.27	3,573,632
Top 4 Customer	BRL Million	3.40	0.00	0.00	0.00	58.12	3,573,632
Top 5 Customer	BRL Million	3.08	0.00	0.00	0.00	55.04	3,573,632
Panel E: Number of business relationships							
Number of Suppliers	Un.	4.77	0.00	0.00	3.00	13.30	3,573,632
Number of Customers	Un.	4.32	0.00	0.00	1.00	17.98	3,573,632
Panel F: Transaction amounts (transfers in 2019)							
Main Bank - Borrower (dummy)	%	36.25	0.00	0.00	100.00	48.07	3,573,632
Main Bank - Top 1 Supplier (dummy)	%	2.95	0.00	0.00	0.00	16.93	3,573,632
Main Bank - Top 1 Customer (dummy)	%	1.96	0.00	0.00	0.00	13.85	3,573,632
Panel G: Loan Terms							
Duration	years	0.880	0.181	0.664	1.274	0.950	3,573,632
Interest Rate	% per year	54.24	12.42	19.21	35.84	91.61	2,963,219

Notes: *Loan* is the outstanding loan portfolio of firm *i* at bank *b*; *All Suppliers* (*All Customers*) is the outstanding amount of loans of all the firm´s suppliers (customers) at the same bank; *Number of Suppliers* (*Customers*) is the number of suppliers (customers) of a given firm with loan amount > 0 at the same bank; *Top n Supplier* (*customer*) is the outstanding loan portfolio at the *n* largest connections of the firm, in which the ordering is measured using transaction values in 2019 (this supplier may or may not have bank loans); *Main Bank - Borrower* is a dummy variable equal to 1 for the bank with the largest loan amount granted to the firm in the previous 4 quarters; *Main Bank Top 1* is a dummy variable equal to 1 for the bank with largest loan exposure to the firm´s Top1 supplier or Top1 customer in the previous 4 quarters; *Duration* is the duration of the loan portfolio of firm *i* at bank *b* in quarter *t*; *Int. Rate (%)* is the value-weighted average interest rate for all fixed rate loans of firm *i* at bank *b* in quarter *t*. Supplier (customer) is defined by any firm that receives (pays) from (to) the firm in 2019 through money transfer or *boleto*. Data are quarterly, from 2018-Q1 to 2020-Q3.

The statistics shown in Panels D and E of Table 1 are analogous to those in Panels A and B, respectively, but we assign zero to the firm-bank-quarter observations in which the firm's customers or suppliers do not have any loans

with the same bank. By construction, the average and median values reported are smaller than those of Panels A and B. Nevertheless, the average number of a firm's suppliers and customers borrowing from the same bank as the firm are respectively 4.77 and 4.32 on average.

Finally, we create, for each bank-firm-quarter observation, a dummy variable that receives a value of 1 if the bank is the main lender of the firm (i.e., the bank with the highest outstanding loan amount for that firm) in the last 4 quarters. The average value for this dummy variable is 0.36, meaning that each firm has on average $1/0.36 \approx 2.8$ lending banks in each 4-quarter period. We also create a dummy variable to indicate whether, for each observation, the main bank of the Top 1 supplier is the bank in that observation and another analogous dummy for the firm's Top 1 customer. Panel F in Table 1 shows that the main bank of the firm's Top 1 supplier (Top 1 customer) is the bank in that observation 2.95% (1.96%) of the time. The last two rows in Panel G of Table 1 present descriptive statistics of loan terms: the median borrower has a loan portfolio duration of 0.66 years (8 months) with its bank, and this portfolio pays a 19.21% interest rate (per year).[13]

[13] Duration is a time-weighted average of outstanding loan amount per maturity, provided the granularity available in the credit bureau. For each outstanding loan we have the amount that is due within 1 to 14 days, 15-30 days, 31-60 days, 61-90 days, 91-180, 181-360, 1-2 years, 2-3 years, 3-4 years, 4-5 years, 5-15 years, >15 years to pay. Using the midpoint of those timespans as a proxy to the time to repay the loan (e.g., 45 days for the 31–60-day bracket), we then calculate an average time to receive the payment for that loan. We apply this procedure to both floating and fixed rate loans.

4. Identification Strategy and regression results

In this section, we layout our identification strategy and regression results in four subsections. The first outlines our assumptions and endogeneity concerns. In the second subsection, we provide evidence on the overlap between bank lending to firms and their commercial counterparties. We then deploy several robustness tests to mitigate potential confounding interpretations and endogeneity concerns. Finally, in the last subsection, we provide causal evidence on how new information about the creditworthiness of the suppliers and customers of a firm affects its borrowing terms.

4.1. Lending Across the Supply Chain

To investigate if – and by how much – the loan amount granted to a firm is associated with the amount of loans provided to its suppliers or customers, we estimate the following models:

$$Loan_{i,b,t} = \beta_0 + \beta_1 * AllSuppliers_{i,b,t-4} + \delta_{i,t} + \mu_{b,t} + \varepsilon_{i,b,t} \quad (1)$$

$$Loan_{i,b,t} = \beta_0 + \beta_1 * AllCustomers_{i,b,t-4} + \delta_{i,t} + \mu_{b,t} + \varepsilon_{i,b,t} \quad (2)$$

where $Loan_{i,b,t}$ is the natural logarithm of the outstanding loan amount from bank b to firm i in quarter t; $AllSuppliers_{i,b,t-4}$ ($AllCustomers_{i,b,t-4}$) is a continuous variable equal to the natural logarithm of loans granted by bank b to all of firm

i's suppliers (customers) a year before[14]. We saturate the model by including $Firm * Time$ ($\delta_{i,t}$) and $Bank * Time$ ($\mu_{b,t}$) fixed effects in all specifications.

$Firm * Time$ fixed effects enhance our identification strategy by controlling for all the borrowers´ unobserved time-variant characteristics. Most importantly, these fixed effects capture the firm's demand for loans in each quarter, as well as other features such as firm size and indebtedness (Khwaja & Mian, 2008). Furthermore, since our mapping of the firms' suppliers and customers is time-invariant (it is based on 2019 data, i.e., it is a static network), all the time-varying heterogeneities in terms of the suppliers' and customers' networks of firm i are already being controlled for. Because we use *firm * time* fixed effects, we restrict our sample to firms that have outstanding loans with at least two different banks in any given quarter. This procedure excludes 10.2% of the observations in the sample.

$Bank * Time$ fixed effects control for any bank-level shock that may affect a bank's lending activities intertemporally. This includes supply-side shocks, such as the opening and closing of branches, funding shocks, interest rate pass-through, and bank-wide credit policy shifts. In all our regressions, the standard errors are robust to heteroscedasticity and clustered at the bank level to account for the correlation of the error term within the observations of the same bank.

[14] Because supplier loans could be zero, either because the supplier network could not be traced or because the suppliers do not share same bank affiliations as the borrower, we add 1 BRL to the outstanding loan portfolio. This does not materially affect any of the inferences since loans, when existent, are normally much larger than 1 BRL (see Table 1).

Given this multitude of fixed effects, our coefficients show the association between lending to the firm's suppliers (or customers) and to the firm itself, comparing the same firm in the same quarter across banks with different exposure to the firm's suppliers (or customers), after partialling out any firm and bank time-variant shocks[15]. Hence, a positive β_1 implies that the amount of loans between bank b and the commercial counterparties of firm i is associated with larger credit granting from bank b to firm i. We also estimate several modified versions of Equations (1) and (2), as we describe in the next subsection.

4.2. Regression Results – Supply Chain Relationships

The output of specification 1 in Panel A of Table 2 provides the first suggestive evidence in favor of our hypothesis: the existence of 'same-bank' loans to *any* of a firm's suppliers is associated with a 14.94% increase in loans to the firm at the same bank on average. The results of Column 2 show that a 100% increase in the loan amount provided to a firm's suppliers translates to a 1.35% increase in the firm's loan amount. Since supplier (customer) loan portfolios, when existent, are typically large, the effect of same-bank lending to the firm and its suppliers is an increase of 23.66% in the amount of loans with the same bank for the median firm, in comparison to loans made by other banks.[16]

[15] Due to the very large number of customers and banks (as well as their interactions terms with the time variable), we "lose" more than 800,000 degrees of freedom after the inclusion of $firm * time$ and $bank * time$ fixed effects. Although we understand that the inclusion of fixed effects is a necessary feature in our model, we have run a series of models without them (omitted here). The results do not change materially.

[16] The median supplier (customer) has a BRL 41.00 million (BRL 19.71 million) portfolio of loans. Therefore, according to specification 2 in Table 2 (Panels A and B), the median borrower receives an additional 0.0135 * Ln (41,000,000) ≈ + 23.7% and 0.0146 * Ln (19,710,000) ≈ + 24.5% in loans when they share same banking affiliation as their supplier and customers, respectively.

The estimates reported in Column 3 of Table 2 show that increasing the number of suppliers that have outstanding loans with the same bank also leads to larger credit granting. Doubling the number of 'same bank' suppliers adds an incremental 11.99% in the amount of loans provided to the firm in comparison to loans made by other banks. This effect increases monotonically in the number of suppliers and customers, as shown in Columns 4 and 5 of Panels A and B, respectively.

Panel B of Table 2 reports the analogous results replacing suppliers with customers. The effect of sharing the same lending bank with *any* of the firm's customers is a 15.60% increase in loans to the firm, whereas doubling the amount of loans to the firm's customers results in a 1.46% increase in lending to the firm. The effect of same-bank lending between the firm and its customers is a 24.52% increase in loans for the median firm. The effect of increasing the number of same-bank customers also increases monotonically (doubling the number of same-bank customers increases loans by 16.5%).

Table 2 - Lending and Business Ties

Panel A - Supplier and Borrower Lending

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)	(3) Ln (Loan)	(4) Ln (Loan)	(5) Ln (Loan)
Dummy (All Suppliers)	0.1494***				
	(0.0445)				
Ln (Loans to all Suppliers)		0.0135***	0.0035		0.0199**
		(0.0029)	(0.0054)		(0.0090)
Ln (Number of Suppliers)			0.1199**		
			(0.0467)		
Dummy (firm has 1 to 5 same-bank suppliers)				0.1421***	-0.1581
				(0.0410)	(0.1258)
Dummy (firm has 6 to 10 same-bank suppliers)				0.2749***	-0.0685
				(0.0558)	(0.1384)
Dummy (firm has 11 to 15 same-bank suppliers)				0.3470***	-0.0119
				(0.0444)	(0.1499)
Dummy (firm has 16 to 20 same-bank suppliers)				0.4096***	0.0412
				(0.0511)	(0.1586)
Dummy (firm has 21+ same-bank suppliers)				0.4574***	0.0711
				(0.1117)	(0.1885)
Constant	12.1509***	12.1156***	12.0888***	12.1089***	12.1031***
	(0.0185)	(0.0207)	(0.0198)	(0.0161)	(0.0169)
Observations	2,468,711	2,468,711	2,468,711	2,468,711	2,468,711
R-squared	0.5093	0.5094	0.5096	0.5096	0.5097
Bank-Time FE	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES
Clusters	115	115	115	115	115

Table 2 - Lending and Business Ties (cont.)

Panel B - Customer and Borrower Lending

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)	(3) Ln (Loan)	(4) Ln (Loan)	(5) Ln (Loan)
Dummy (All Customers)	0.1560***				
	(0.0356)				
Ln (Loans to all customers)		0.0146***	0.0014		0.0243***
		(0.0022)	(0.0056)		(0.0055)
Ln (Number of customers)			0.1650***		
			(0.0619)		
Dummy (firm has 1 to 5 same-bank customers)				0.1441***	-0.2046**
				(0.0338)	(0.0885)
Dummy (firm has 6 to 10 same-bank customers)				0.2999***	-0.1042
				(0.0489)	(0.0924)
Dummy (firm has 11 to 15 same-bank customers)				0.4071***	-0.0173
				(0.0727)	(0.0858)
Dummy (firm has 16 to 20 same-bank customers)				0.4537***	0.0164
				(0.1083)	(0.1116)
Dummy (firm has 21+ same-bank customers)				0.6009***	0.1398
				(0.1286)	(0.1150)
Constant	12.1619***	12.1335***	12.1036***	12.1242***	12.1176***
	(0.0116)	(0.0119)	(0.0135)	(0.0110)	(0.0114)
Observations	2,468,711	2,468,711	2,468,711	2,468,711	2,468,711
R-squared	0.5093	0.5095	0.5098	0.5097	0.5098
Bank-Time FE	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES
Clusters	115	115	115	115	115

Notes: *Loan*, All Suppliers, All Customers and *Number of Suppliers* (*Customers*) are defined as in Table 1; *Dummy (All Suppliers)* and *Dummy (All Customers)* is a binary variable equal to one if any of the firm´s suppliers or customers, respectively, has an outstanding loan at the same bank; The dummies "*firm has N to M same-bank suppliers*" and "*firm has N to M same-bank customers*" receives 1 if the number of suppliers (or customers, respectively) that have outstanding loans with the same bank is between N and M, and 0 otherwise. All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

4.3. Robustness Tests

We start by checking whether the intensity (rather than the mere existence) of the relationship of a bank with a firm's suppliers (or customers) increases the amount of loans from that bank to the firm. The estimations in Table 3 show that a supplier´s close relationship with its bank also plays an important role in cross-client bank lending. In Column 1, we create a dummy (*main bank(top1)*) that takes a value of 1 if bank *b* is the lender with the largest amount of loans to the top supplier (or customer, in the analogous regressions) of firm *i*. The results from Column 1 of Panel A and Panel B show that being the main bank of the firm's Top 1 supplier or Top 1 customer is associated with an increase of 14.76% or 19.03%, respectively, in terms of the firm's loan amount outstanding with the same bank.

Furthermore, in the specification reported in Column 2 of Table 3, we add a dummy variable that is equal to 1 if bank *b* is the main lender of borrower *i*. The first coefficient is slightly smaller than the analogous coefficients reported in Column 1. As expected, the coefficient of the main bank is large and statistically significant,[17] and the coefficient of the interaction *main bank*main bank (top1)* is negative and smaller in magnitude than the first coefficient. Indeed, in Panel A, the sum of the first and third coefficients is not statistically significant, meaning that the additional effect of a bank being the main bank of both a firm and its

[17] According to Panel A (Panel B) the largest financier of the firm grants +202.93% (+202.63%) in credit. This is an expected result since the definition of "main bank" is based on the (previous 12 months) loan portfolio size.

main supplier is insignificant. Nonetheless, in Panel B, we still find a positive effect on the bank being the main bank of the firm and its main supplier at the same time.[18]

Finally, to measure relationship intensity in a more granular manner, we replace the two *main bank* dummies with two other variables used in the literature, which are the length of relationship and proportion of the firms' total borrowing from a given bank. In the estimations reported in Columns 3 to 6 of Table 3, the results are analogous to the first two columns and apply to both the top supplier (Panel A) and the top customer (Panel B): a more intense bank relationship with the firm´s commercial counterparties leads to larger credit granting to the firm. The results reported in the appendix (Table A.5) show that a bank having a close relationship to *both* the firm and its main supplier or customer implies a larger amount of loans obtained from that bank.[19]

[18] The sum of the first and third coefficients is positive, and the *p value* of the sum is equal to 0.0129.

[19] Using the results from Table A.8 in the Appendix, we can check that is indeed true. Regarding the RelationYears measure, at the median firm being close both to the borrower and to the Top 1 supplier has an effect of *0.0078 * (28.55) – 0,0004 * (213.52) = +0.1372*, whereas being close to the borrower and to the Top 1 customer has an effect of *0.0072 * (26.01) – 0.0003 * (196.20) = +0.1284*. Regarding the *BankShare* measure, the effects are *0.0032 * (47.21) -0.0001 * (1363.48) = +0.0147* [supplier], and *0.0026 * (43.86) -0.000049 (1310.25) = 0.0498* [customer].

Table 3 - Main Bank Associations

Panel A - Most Relevant Supplier (i.e. Top1 Supplier)

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)	(3) Ln (Loan)	(4) Ln (Loan)	(5) Ln (Loan)	(6) Ln (Loan)
Main Bank of Top1 Supplier	0.1476***	0.1367***				
	(0.0317)	(0.0272)				
Main Bank of the Borrower		2.0293***				
		(0.0624)				
Main Bank Top1 * Main Bank Borrower		-0.1519***				
		(0.0329)				
RelationYears Top1			0.0021*	0.0078***		
			(0.0012)	(0.0012)		
RelationYears of borrower				0.0202***		
				(0.0035)		
RelationYears Top1 * RelationYears				-0.0004***		
				(0.0001)		
Bank Share Top1					0.0021***	0.0032***
					(0.0006)	(0.0007)
Bank Share						0.0322***
						(0.0008)
Bank Share Top1 * Bank Share						-0.0001***
						(0.0000)
Constant	12.0130***	11.4121***	12.2080***	11.9857***	12.2075***	11.2205***
	(0.0009)	(0.0186)	(0.0027)	(0.0387)	(0.0014)	(0.0263)
Observations	3,211,146	3,211,146	2,468,711	2,468,711	2,468,711	2,236,864
R-squared	0.4789	0.5988	0.5092	0.5109	0.5092	0.6220
Bank-Time FE	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES
Clusters	126	126	115	115	115	115

Table 3 - Main Bank Associations (cont.)

Panel B - Most Relevant Customer (i.e. Top1 Customer)

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)	(3) Ln (Loan)	(4) Ln (Loan)	(5) Ln (Loan)	(6) Ln (Loan)
Main Bank of Top1 Customer	0.1903***	0.1444***				
	(0.0278)	(0.0319)				
Main Bank of the Borrower		2.0263***				
		(0.0629)				
Main Bank Top1 * Main Bank Borrower		-0.0994**				
		(0.0417)				
RelationYears Top1			0.0027***	0.0072***		
			(0.0008)	(0.0014)		
RelationYears				0.0194***		
				(0.0035)		
RelationYears Top1 * RelationYears				-0.0003***		
				(0.0001)		
Bank Share Top1					0.0021***	0.0026***
					(0.0004)	(0.0007)
Bank Share						0.0321***
						(0.0008)
Bank Share Top1 * Bank Share						-0.0000***
						(0.0000)
Constant	12.0136***	11.4133***	12.2088***	11.9956***	12.2093***	11.2247***
	(0.0005)	(0.0187)	(0.0012)	(0.0384)	(0.0008)	(0.0260)
Observations	3,211,146	3,211,146	2,468,711	2,468,711	2,468,711	2,236,864
R-squared	0.4789	0.5988	0.5092	0.5108	0.5092	0.6219
Bank-Time FE	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES
Clusters	126	126	115	115	115	115

Notes: Loan is defined as in Table 1; *Main Bank of the Borrower, Main Bank of the Top1 Supplier* and *Main Bank of the Top1 Customer* are dummy variables equal to 1 for the bank with the largest 12 month loan exposure to the borrower, the Top1 supplier and the Top1 customer, respectively; *RelationYears* is the number of years of relationship between the borrower and the bank; *RelationYears Top1* are the analogous figures for the firm's Top1 supplier (Panel A) and Top1 customer (Panel B); *Bank Share* is the share of the bank in the borrower's loan portfolio; *Bank Share Top1* are the analogous figures for the firm's Top1 supplier (Panel A) and Top1 customer (Panel B). All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

Another valid concern is that borrowers who deal with suppliers who share banking affiliations are (nonlinearly) different from their counterparties. Moreover, the real mechanism behind borrower and supplier (or customer) loans

portfolios relation could be blurred by disappearing firms, (e.g. due to the write-off of "falling angels" portfolios).[20] To address these concerns, we filter our sample in the specifications reported in Table 4 as follows: (i) for firms that have at least one supplier or one customer that have loans with the same bank (Columns 1 and 4); (ii) for borrowers that survived throughout the entire sample period (Columns 2 and 5) and (iii) for both previous filters simultaneously (Columns 3 and 6). We still find a positive coefficient for the effect of loans to suppliers (Columns 1 to 3) and to customers (Columns 4 to 6) on the firm's own amount of loans outstanding with the bank. Hence, we understand that neither of these alternative mechanisms seem to drive our previous results.

Although the presence of bank and firm time-variant fixed effects alleviates identification concerns over supply-side and demand-side driven unobserved heterogeneities, a possible concern is that borrowers might be transferring resources (e.g., trade credit) to their suppliers and customers to prevent them from being credit constrained (Biais and Gollier 1997, Petersen and Rajan 1997). Table A.1 in the appendix reports separate regression estimations for each quarter between 2018 and 2020 (i.e., cross-sectional regressions), and the results are qualitatively similar. Since our definition of the business relationships between firms relies on 2019 money transfer data, it is very unlikely that this mechanism brings any bias into *every* period of cross-sectional regressions.

[20] Falling angels are firms that had good access to financing, and then turn into distressed firms. Because our measure of credit only deals with 'active' portfolios (i.e., those in the banks' balance sheet) we may be losing some of these worsening firms.

Another concern is that irrelevant business ties (e.g., suppliers that received small shares of a firm's money transfers) could also add noise to our results, as such ties might lead to unreliable (or irrelevant) sources of information to the lender. The results displayed in Table A.2 in the appendix show that sharing the same bank with the firm's five main suppliers (or borrowers) also increases the amount of loans provided to the firm. These results strengthen our previous inference: lending to customers and suppliers of a firm increases the amount of loans provided to this firm.

Thus far, our main independent variables (i.e., $AllSuppliers_{i,t-4}$ and $AllCustomers_{i,t-4}$) have not included any information regarding money transfer *volume*; they have only included the existence of such transfers along with suppliers and customers ranking in order of importance. To take the relevance of customers' and suppliers' transactions into account, we perform a robustness test that weighs the bank loans to suppliers and customers by the proportion of their respective transfer volumes to the firms' total payments made to each of the five largest suppliers. Similarly, we factor in the proportion of payments received from the firm's customers. We report these estimations in Table A.3 (in the appendix) and find that the "weighted" versions of $AllSuppliers_{i,t-4}$ and $AllCustomers_{i,t-4}$ are positive and significantly different from zero.

An additional critique to the previous models is the lack of causal inference. For instance, one could argue that time-variant bank-firm relationship quality is an omitted variable in the model. Creditworthy borrowers endogenously - and intertemporally - choose to be surrounded by good suppliers and customers.

Banks may acknowledge this fact and grant larger loans to these connected firms, leading to an upward bias in β_1.[21] We mitigate such concerns by adding *bank* * *risk* * *quarter* fixed effects.[22] Banks may also engage in deeper cross-client relationship lending by means of specialization in certain industries or in geographical areas.[23] To mitigate these concerns, we add *bank* * *sector* * *time* fixed effects and *bank* * *county* * *time* fixed effects. The results of these estimations are reported in Table A.4 in the appendix. Because our coefficients of interest (i.e., $AllSuppliers_{i,t-4}$ and $AllCustomers_{i,t-4}$) are still positive and close in magnitude to those presented previously (see Table 2), we conclude that these effects, if existent, do not invalidate our previous inferences.

Finally, it is possible that the same firm may be the borrower´s most relevant supplier and most relevant customer *at the same time*. In fact, out of the observations of 1.90 million Top 1 suppliers and 1.86 million Top 1 customers that could be traced, only 35,547 show an overlap between the two. Notwithstanding the small magnitude of the overlapping set, firms in this very particular situation could have driven our previous results. To address this concern, we run a model that uses *net* customer and *net* supplier loan exposure by consolidating both measures in the same model. The results of these

[21] Note that these relationships must be evolving through time, as we have shown that even cross-section models also show the same pattern (Appendix Table A.1).

[22] *Risk* is measured by the borrowers' rating attributed by the bank (using a standardized rating scale adopted by the Central Bank).

[23] For example, a bank might decide to open new branches to be closer to a set of potentially desired borrowers.

exercises, reported in Table A.5 in the appendix, show that our main inferences remain valid.

Table 4 - Robustness (II): firms that survived and firm non-zero network exposure

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)
Model Type	AllSupplier >0	Survived	AllSupplier >0 & Survived	AllCustomer >0	Survived	AllCustomer >0 & Survived
Ln (All Suppliers)	0.0228***	0.0138***	0.0239***			
	(0.0064)	(0.0029)	(0.0066)			
Ln (All Customers)				0.0247***	0.0145***	0.0240***
				(0.0052)	(0.0022)	(0.0053)
Constant	12.0767***	12.1388***	12.0856***	12.2400***	12.1593***	12.2799***
	(0.1098)	(0.0210)	(0.1139)	(0.0842)	(0.0123)	(0.0873)
Observations	976,371	2,309,184	920,779	752,536	2,309,184	713,922
R-squared	0.5256	0.5067	0.5235	0.5288	0.5067	0.5270
Bank-Time FE	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES
Clusters	95	113	95	94	113	93

Notes: Columns (1) and (4) are the baseline model, restricted to only firms with a nonzero loan portfolio at the same bank; Columns (2) and (5) are the baseline model with firms only appearing in all quarters of the sample; Columns (3) and (6) use the intersection of the two previous conditions. Variables are defined as in Table 1. All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

4.4. Do banks respond to negative surprises conveyed by loans to commercial counterparties?

The results shown in the previous sections suggest that lending to firms linked by business ties seems to provide information to banks about their borrowers. Therefore, according to our second hypothesis, we expect that when a negative credit event occurs to a connected firm, such as a loan falling into arrears, valuable information is conveyed to banks in their credit granting process, and the banks respond by adjusting the loan supply to these firms.

To test this hypothesis, we perform a differences-in-differences analysis. Our treatment variable (*Arrears*) is an indicator that assumes a value equal to 1 if firm *i*'s top supplier has any loan falling into arrears for 14 days or more with bank *b* in a given quarter (but did not in the previous four quarters) and zero otherwise. Because firm *i*'s top supplier did not have any loans in arrears with the same bank in the previous year, the information is a "negative surprise shock" to the bank about the creditworthiness of firm *i*'s top supplier. Since our treatment events are staggered over time, we adopt the stacked approach (for example, as in Gormley and Matsa, 2011), i.e., we pool the data across quarters (cohorts) *c* to estimate the average treatment effect, as described in Equation (3). We use eight quarters of data around each cohort *c*.

$$LoanTerms_{i,b,t,c} = \omega_0 + \omega_1 arrears_{i,b,c} + \omega_2 Post_{t,c} * arrears_{i,b,c} + \delta_{i,t,c} + \mu_{b,t,c} + \varepsilon_{i,b,t,c} \quad (3)$$

$Post_{t,c}$ is a dummy that takes a value equal to 1 in the four quarters that follow cohort (quarter) c and 0 in the four quarters preceding it.[24]

We use three different measures for the dependent variable, $LoanTerms_{i,b,t,c}$: i) the loan amount outstanding of firm i with bank b in quarter t for cohort c; ii) the average interest rate charged by bank b for firm i in quarter t for cohort c; iii) the average duration of the loans provided by bank b to firm i in quarter t for cohort c.

Our main coefficient of interest is ω_2, which shows, for a given borrower that has loans with at least two banks, how its loan terms with bank A change when bank A receives a negative surprise from its lending relationship with the firm`s top supplier, in comparison to the change in its loan terms with bank B, which does not receive such negative information. *Bank * time * cohort* fixed effects are denoted by $\mu_{b,t,c}$ and account for supply-side shocks at different banks in each quarter by cohort. Our regressions also include *firm * time * cohort* fixed effects to account for each firm`s demand for loans and any change in its creditworthiness that can be inferred by all its lending banks. Since our network of suppliers is static (i.e., time invariant), we also have an embedded fixed effect on "$top\ supplier * time$" in the specification of Equation (3). This econometric feature of our model controls for supplier and customer time-variant heterogeneities (e.g., an overall deterioration of the creditworthiness of the commercial counterparty that could be observed by all the banks that lend to

[24] We exclude the observations from the quarter in which the shock happens.

firm *i*). Therefore, the only variation that is left in this setup is the bank-firm-supplier relationship. Because of this aspect, we include only firms that have loans with at least two banks in the four quarters that precede the shock and the four quarters following the shock for every cohort *c*.

The results reported in Columns 1 to 3 of Table 5 show that the loan terms from a bank to a firm worsen because of negative information received by the bank about the firm's main supplier. The estimate of the *Post* * *arrears* coefficient in Column 1 shows that the bank-to-firm loan amount decreases by 7.7% when the firm's major supplier falls into arrears with the bank in the previous quarter in comparison to the change in the amount of loans from other banks to the same firm. This result is statistically significant at the 1% level and is economically relevant. The estimates from Columns 2 and 3 of Table 5 show that there is a 5.6% decrease in the duration of loans and an 8.2 percentage point increase in the interest rate charged by the bank that receives negative information about the firm's main supplier in comparison to the change in the loan terms provided by other banks.

We also estimate analogous regressions in which the *arrears* variable indicates that a loan of firm *i*˜s top customer falls into arrears with bank *b*. The estimates reported in Columns 5 and 6 of Table 5 indicate that the bank that receives negative information about the firm's main customer reduces the duration of loans by 8.5% and increases the interest rate by 4.9 percentage points more than other banks. The coefficient of interest reported in Column 4 (for loan amount) is not statistically significant.

Table 5 - Response to main commercial counterparty falling into arrears

	(1)	(2)	(3)	(4)	(5)	(6)
	Top 1 Supplier falls into arrears			Top 1 Customer falls into arrears		
	Ln(Loans)	Ln(duration)	Int. rate	Ln(Loans)	Ln(duration)	Int. rate
Arrears	-0.1315	-0.0687**	-5.8106*	0.0044	-0.0014	-0.8106
	(0.0944)	(0.0292)	(2.9281)	(0.0400)	(0.0354)	(2.3998)
Arrears * Post	-0.0770***	-0.0565*	8.2025**	0.0635	-0.0851**	4.9100**
	(0.0228)	(0.0322)	(3.9749)	(0.0729)	(0.0385)	(2.1516)
Constant	13.0939***	-0.6183***	40.8128***	13.2505***	-0.6641***	38.9618***
	(0.0019)	(0.0008)	(0.0530)	(0.0011)	(0.0010)	(0.0444)
Observations	262,360	262,360	216,689	187,084	187,084	150,943
R-squared	0.6829	0.5801	0.5207	0.6776	0.6085	0.5367
Bank-Time-Cohort FE	YES	YES	YES	YES	YES	YES
Borrower-Time-Cohort FE	YES	YES	YES	YES	YES	YES
Clusters	40	40	36	38	38	33

Notes: *Loan* is defined as in Table 1; *Int. Rate (%)* is the value-weighted average interest rate for all fixed rate loans of firm *i* at bank *b* in quarter *t*; *Ln (duration)* is the natural logarithm of the duration of the loan portfolio of firm *i* at bank *b* in quarter *t; arrears* is an indicator that assumes value of 1 if firm i's top supplier (or customer) has any loan falling into arrears for 14 days or more with the bank in a given quarter (but not in the previous quarter), and zero otherwise. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. *Post* is a dummy that assumes 1 in the four quarters that follow cohort c and 0 in the four quarters preceding it. Robust standard errors clustered at the bank level are reported in parentheses.

Further, we investigate whether network-wide information also conveys valuable information to banks' risk assessment. To do that, we estimate a panel regression, in which our main covariate, *ratio in arrears*, is the ratio of loans that are 14 days or more in arrears of *all* suppliers (or *all* customers) of firm i with bank b in the previous four quarters. More specifically, we estimate Equation (4):

$$LoanTerms_{i,b,t} = \gamma_0 + \gamma_1 * ratio\ in\ arrears_{i,[t-4;t-1]} + \delta_{i,t} + \mu_{b,t} + \varepsilon_{i,b,t} \quad (4)$$

where $LoanTerms_{i,b,t}$ are the same three measures used in the estimation of Equation 3 (loan amount, average duration and average interest rate). We also saturate the regression with *borrower*quarter* and *bank*quarter* fixed effects to control for time-varying overall firm demand for loans and bank supply of loans.

Our coefficient of interest is γ_1. Our strategy compares the banks' response to firms with 'good' business ties (i.e., firms with ties to other firms without any loan in arrears in the same bank) to firms with loans in arrears for 14 days or more with the same bank in any of the previous four quarters. In alternative specifications, we replace the ratio of loans in arrears with the number of suppliers (or customers) that have loans in arrears with the same bank in the previous four quarters.

The results reported in Columns 1 through 4 of Table 6 – Panel A - show that the amount of loans to the firm decreases as a result of an increase in the number of commercial counterparties that have loans falling into arrears (and along with the ratio of loans in arrears), although the results are statistically significant in only two of the specifications. Specifically, the estimate in Column 2 indicates that a 10% increase in the number of suppliers with loans in arrears decreases the loan portfolio size by 1.67%, whereas the results of Column 3 show that a 1 percentage point increase in the ratio of loans in arrears by the firm's customers decreases the loan amount with the same bank by 0.15%.

The results of Table 6 also suggest that negative information about the firm's counterparties negatively affects the firm's loan terms. A 10% increase in the number of suppliers with loans in arrears increases interest rates by 0.52 percentage points (Panel A, Column 6), decreases portfolio duration by 1.20% (Panel B, Column 2) and adds a further 0.04% to the ratio of the borrower's portfolio in arrears (Panel B, Column 6). Similar qualitative results hold for the

ratio of network in arrears and the number of customers who are 14 days in arrears.

Taken together, the results that we document in this paper strongly suggest that lending to connected firms allows banks to incorporate valuable information about their borrowers. This information is used in the banks' loan granting process, as banks lend more to firms that share the same lending bank as their suppliers or customers. At the same time, banks also learn from negative shocks that occur to a firm's commercial counterparties, and thereby adjust their lending supply accordingly by reducing loan amounts, increasing interest rates, and reducing loan duration in comparison to other banks.

Table 6 - Negative Surprise in the Network of Supplier or Customers and Loan Terms

Panel A

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Ln (loans) [BRL, winsorized]				Int. Rate [%, winsorized]			
14 days in arrears [ratio] - All Suppliers	-0.1100				-0.7544			
	(0.0949)				(2.0860)			
Ln (# of suppliers with >14 days in arrears loans)		-0.1673**				5.2447*		
		(0.0811)				(3.0935)		
14 days in arrears [ratio] - All Customers			-0.1511**				-0.5808	
			(0.0620)				(2.3654)	
Ln (# of customers with >14 days in arrears loans)				-0.0905				5.4528**
				(0.0802)				(2.4802)
Constant	12.4701***	12.4933***	12.6474***	12.6605***	47.8364***	47.1628***	46.9713***	46.1831***
	(0.0005)	(0.0115)	(0.0005)	(0.0128)	(0.0105)	(0.3950)	(0.0207)	(0.3562)
Observations	974,327	974,327	748,145	748,145	791,895	791,895	601,805	601,805
R-squared	0.5245	0.5248	0.5280	0.5281	0.4517	0.4520	0.4536	0.4538
Bank-Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Clusters	94	94	92	92	80	80	79	79

Table 6 - (cont.)
Panel B

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	Ln (duration) [years, winsorized]				14 days in arrears [ratio]			
14 days in arrears [ratio] - All Suppliers	-0.1638*				0.0196**			
	(0.0862)				(0.0076)			
Ln (# of suppliers with >14 days in arrears loans)		-0.1203***				0.0041***		
		(0.0341)				(0.0015)		
14 days in arrears [ratio] - All Customers			-0.1835**				0.0239**	
			(0.0758)				(0.0094)	
Ln (# of customers with >14 days in arrears loans)				-0.0717*				0.0006
				(0.0369)				(0.0010)
Constant	-0.8590***	-0.8427***	-0.8674***	-0.8576***	0.0217***	0.0212***	0.0207***	0.0208***
	(0.0005)	(0.0048)	(0.0007)	(0.0059)	(0.0000)	(0.0002)	(0.0001)	(0.0002)
Observations	974,327	974,327	748,145	748,145	974,327	974,327	748,145	748,145
R-squared	0.4908	0.4913	0.4817	0.4818	0.5435	0.5435	0.5371	0.5370
Bank-Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES	YES	YES
Clusters	94	94	92	92	94	94	92	92

Notes: *Loan* is defined as in Table 1; *Int. Rate (%)*, *Ln (duration)* and *14 days in arrears [ratio]* are defined as in Table 5; *14 days in arrears [ratio] - All Suppliers (Customers)* are the ratios between the portfolio above 14 days in arrears to the portfolio size of all suppliers (customers); *Ln (# of suppliers (customers) with >14 days in arrears loans)* is the natural logarithm of the number of suppliers (or customers) with any outstanding loan portfolio with bank *b* in arrears for longer than 14 days. These estimations include only firms with at least one supplier or one customer whose loan portfolio is greater than zero in the previous year. All independent variables are measured a single previous year. We denote significance at 10%, 5%, and 1% with ∗, ∗∗, and ∗∗∗, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

5. Conclusion

This paper shows that bank lending across the supply chain conveys information to banks that lend to medium and large firms in Brazil. For a given firm, doubling the size of the loans granted by a bank to the network of suppliers or customers entails a 1.35% and a 1.46% increase in the firm's amount of loans extended from that bank, respectively. For the median borrower, sharing a bank lending relationship with its suppliers translates into an increase of 23.7% in loans by that same bank, whereas borrower and customer banking overlap adds slightly more, 24.5%, to its loans from that bank. We also show that increasing the number of suppliers or customers that have loans with the same bank as the borrower also results in higher bank lending to that borrower. These results are not driven by firm or bank heterogeneity, as we use bank-time and firm-time fixed effects to account for bank heterogeneity in loan supply and firm heterogeneity in loan demand in every period respectively.

These findings maintain their validity after a variety of robustness tests. For example, as we control for bank lending specialization to certain sectors, geographic location of the borrower, and bank-risk time-varying fixed effects, our findings do not change materially. Similarly, survivorship bias does not seem to be a driver of the results.

We also show that lending to supply chain counterparties that experience a negative creditworthiness shock leads to smaller credit granting, higher interest rates and lower loan portfolio duration. These effects strongly suggest that banks

re-estimate the risk of firms by incorporating valuable information that they obtain from lending to the firm's customers and suppliers. Indeed, the information content from lending to the firm's business ties allows banks to anticipate future contagion, which we also verify in our data.

To summarize, in this paper, we provide empirical evidence that borrowers benefit from a larger access to loans when their suppliers and customers share the same lending bank. Additionally, we show that banks react to negative information about the firm's commercial counterparties creditworthiness by tightening the firm's loan terms.

The avenues for future research are promising. It would be interesting to understand the firm-level implications of our results in terms of incentives for firms in choosing their lending banks. First, firms may induce their business partners to migrate toward the same financial institution to obtain further access to loans; second, they could *ex ante* choose a bank that already has relationships with their business ties to obtain more favorable access to financing.

Another possible research stream would be to examine the bank-level incentives of this feature. The overlap of network loan exposures and loss-given default minimization may induce banks to forbear existing loans (Mourad et al. 2020; Bonfim et al., 2021) or postpone judicial recovery processes when they foresee negative network externalities. Finally, one could study, for instance, other types of cross-client exposures that stem not only from loans but also from other types of contingent exposures such as lines of credit and OTC derivatives.

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APPENDIX

Table A.1 - Cross-section regressions

Panel A - Supplier and Borrower Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)
Ln (All Suppliers)	0.0129***	0.0135***	0.0138***	0.0124***	0.0144***	0.0139***	0.0148***	0.0133***	0.0141***	0.0131***	0.0124***
	(0.0030)	(0.0032)	(0.0031)	(0.0031)	(0.0033)	(0.0033)	(0.0029)	(0.0034)	(0.0029)	(0.0030)	(0.0027)
Constant	12.1226***	12.1286***	12.1421***	12.1667***	12.1472***	12.0579***	12.0672***	12.1251***	12.1202***	12.0362***	12.1597***
	(0.0203)	(0.0217)	(0.0212)	(0.0215)	(0.0234)	(0.0241)	(0.0211)	(0.0251)	(0.0216)	(0.0229)	(0.0208)
Observations	228,754	224,266	221,171	221,955	220,926	224,572	223,990	224,090	223,456	227,464	228,067
R-squared	0.5253	0.5249	0.5259	0.5274	0.5264	0.5034	0.5019	0.4989	0.5038	0.4923	0.4931
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Period	Mar-18	Jun-18	Sep-18	Dec-18	Mar-19	Jun-19	Sep-19	Dec-19	Mar-20	Jun-20	Sep-20
Clusters	103	106	104	106	104	104	104	103	102	104	103

Panel B - Customer and Borrower Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)
Ln (All Customers)	0.0130***	0.0118***	0.0139***	0.0149***	0.0139***	0.0158***	0.0154***	0.0149***	0.0156***	0.0158***	0.0154***
	(0.0024)	(0.0025)	(0.0024)	(0.0026)	(0.0028)	(0.0022)	(0.0023)	(0.0026)	(0.0021)	(0.0021)	(0.0024)
Constant	12.1433***	12.1605***	12.1649***	12.1744***	12.1748***	12.0725***	12.0909***	12.1400***	12.1379***	12.0458***	12.1660***
	(0.0123)	(0.0131)	(0.0125)	(0.0136)	(0.0152)	(0.0119)	(0.0125)	(0.0145)	(0.0120)	(0.0119)	(0.0140)
Observations	228,754	224,266	221,171	221,955	220,926	224,572	223,990	224,090	223,456	227,464	228,067
R-squared	0.5253	0.5248	0.5259	0.5275	0.5264	0.5035	0.5019	0.4990	0.5039	0.4924	0.4932
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Period	Mar-18	Jun-18	Sep-18	Dec-18	Mar-19	Jun-19	Sep-19	Dec-19	Mar-20	Jun-20	Sep-20
Clusters	103	106	104	106	104	104	104	103	102	104	103

Notes: *Loan* and *All Suppliers* (*All Customers*) are defined as in Table 1. All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

Table A.2 - Top 1 to 5 Most Relevant Business Relationships

Panel A - Most Relevant Suppliers

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)
Dummy (Top 1 Supplier)	0.0746***	
	(0.0274)	
Dummy (Top 2 Supplier)	0.0747***	
	(0.0158)	
Dummy (Top 3 Supplier)	0.0310*	
	(0.0163)	
Dummy (Top 4 Supplier)	0.0864***	
	(0.0212)	
Dummy (Top 5 Supplier)	0.0552**	
	(0.0221)	
Ln (Loans) of Top 1 Supplier		0.0048**
		(0.0019)
Ln (Loans) of Top 2 Supplier		0.0055***
		(0.0011)
Ln (Loans) of Top 3 Supplier		0.0033***
		(0.0013)
Ln (Loans) of Top 4 Supplier		0.0066***
		(0.0016)
Ln (Loans) of Top 5 Supplier		0.0038**
		(0.0016)
Constant	12.1866***	12.1844***
	(0.0060)	(0.0059)
Observations	2,468,711	2,468,711
R-squared	0.5093	0.5093
Bank-Time FE	YES	YES
Borrower-Time FE	YES	YES
Clusters	115	115

Table A.2 - Top 1 to 5 Most Relevant Business Relationships (cont.)

Panel B - Most Relevant Customers

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)
Dummy (Top 1 Customer)	0.0870***	
	(0.0241)	
Dummy (Top 2 Customer)	0.0155	
	(0.0322)	
Dummy (Top 3 Customer)	0.0449*	
	(0.0247)	
Dummy (Top 4 Customer)	0.0829***	
	(0.0287)	
Dummy (Top 5 Customer)	0.1160***	
	(0.0268)	
Ln (Loans) of Top 1 Customer		0.0062***
		(0.0016)
Ln (Loans) of Top 2 Customer		0.0004
		(0.0025)
Ln (Loans) of Top 3 Customer		0.0032*
		(0.0017)
Ln (Loans) of Top 4 Customer		0.0065***
		(0.0019)
Ln (Loans) of Top 5 Customer		0.0086***
		(0.0020)
Constant	12.1923***	12.1916***
	(0.0050)	(0.0044)
Observations	2,468,711	2,468,711
R-squared	0.5093	0.5093
Bank-Time FE	YES	YES
Borrower-Time FE	YES	YES
Clusters	115	115

Notes: *Loan*, *Top n Supplier* (*Top m Customer*) are defined as in Table 1. All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

Table A.3 - Robustness: Lending and Business Ties (weightning by transaction relevance)

Panel A - Supplier and Borrower Lending

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)	(3) Ln (Loan)
Ln (All Suppliers) (weighted)	0.0147***	0.0037	0.0170**
	(0.0030)	(0.0058)	(0.0077)
Ln (Number of Suppliers)		0.1195**	
		(0.0471)	
Dummy (firm has 1 to 5 same-bank suppliers)			-0.0888
			(0.0973)
Dummy (firm has 6 to 10 same-bank suppliers)			0.0053
			(0.1097)
Dummy (firm has 11 to 15 same-bank suppliers)			0.0641
			(0.1174)
Dummy (firm has 16 to 20 same-bank suppliers)			0.1186
			(0.1248)
Dummy (firm has 21+ same-bank suppliers)			0.1513
			(0.1584)
Constant	12.1141***	12.0889***	12.1017***
	(0.0204)	(0.0196)	(0.0173)
Observations	2,468,711	2,468,711	2,468,711
R-squared	0.5094	0.5096	0.5096
Bank-Time FE	YES	YES	YES
Borrower-Time FE	YES	YES	YES
Clusters	115	115	115

Table A.3 - Robustness: Lending and Business Ties (weightning by transaction relevance) (cont.)

Panel B - Customer and Borrower Lending

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)	(3) Ln (Loan)
Ln (All Customers) (weighted)	0.0171***	0.0030	0.0245***
	(0.0025)	(0.0062)	(0.0051)
Ln (Number of Customers)		0.1568**	
		(0.0620)	
Dummy (firm has 1 to 5 same-bank customers)			-0.1626**
			(0.0737)
Dummy (firm has 6 to 10 same-bank customers)			-0.0665
			(0.0784)
Dummy (firm has 11 to 15 same-bank customers)			0.0194
			(0.0758)
Dummy (firm has 16 to 20 same-bank customers)			0.0530
			(0.1058)
Dummy (firm has 21+ same-bank customers)			0.1771
			(0.1133)
Constant	12.1278***	12.1014***	12.1145***
	(0.0122)	(0.0136)	(0.0116)
Observations	2,468,711	2,468,711	2,468,711
R-squared	0.5095	0.5098	0.5098
Bank-Time FE	YES	YES	YES
Borrower-Time FE	YES	YES	YES
Clusters	115	115	115

Notes: *Loan* and *Number of Suppliers* (*Customers*) are defined as in Table 1; *All Suppliers (weighted)* (*Customers*) is the outstanding amount of loans of all the firm´s suppliers (customers), weighted by each supplier (customer) transaction relevance in 2019; *Dummy (firm has N to M same-bank suppliers)* (*customers*) is a binary variable equal to one if the bank lends to the firm and to a number of suppliers (customers) between N and M. All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

Table A.4 - Robustness: risk, sector and geographic location

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)	(3) Ln (Loan)	(4) Ln (Loan)	(5) Ln (Loan)	(6) Ln (Loan)
Ln (All Suppliers)	0.0077***	0.0099***	0.0109***			
	(0.0014)	(0.0023)	(0.0029)			
Ln (All Customers)				0.0099***	0.0110***	0.0104***
				(0.0014)	(0.0017)	(0.0021)
Constant	12.1490***	12.1386***	12.1388***	12.1511***	12.1504***	12.1606***
	(0.0102)	(0.0169)	(0.0212)	(0.0079)	(0.0094)	(0.0115)
Observations	2,451,296	2,464,684	2,264,470	2,451,296	2,464,684	2,264,470
R-squared	0.7477	0.5258	0.5601	0.7478	0.5259	0.5600
Bank-Time FE	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES
Risk-Bank-Time FE	YES	NO	NO	YES	NO	NO
Sector-Bank-Time FE	NO	YES	NO	NO	YES	NO
Geo-Bank-Time FE	NO	NO	YES	NO	NO	YES
Clusters	108	108	104	108	108	104

Notes: *Loan* and *All Suppliers* (*All Customers*) are defined as in Table 1. *Risk-Bank-Time FE* refers to fixed effects for each bank-borrower-time with different risk classification (using a nine-grade standard rating that banks inform to the Central Bank of Brazil); *Sector-Bank-Time FE* is a fixed effect for each bank-borrower-time within sector classification (there are 24 sectors in the Central Bank of Brazil definition); *Geo-Bank-time FE* is a fixed effect for borrower-bank-time according to the geographical location of the borrower (i.e. county code). All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

Table A.5 - Lending and Business Ties (Supplier and Customers)

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)	(3) Ln (Loan)
Dummy (All Suppliers)	0.1208***		
	(0.0398)		
Dummy (All Customers)	0.1332***		
	(0.0298)		
Ln (All Suppliers)		0.0102***	0.0057
		(0.0026)	(0.0045)
Ln (All Customers)		0.0118***	0.0006
		(0.0016)	(0.0048)
Ln (Number of Suppliers)			0.0399
			(0.0336)
Ln (Number of Customers)			0.1319**
			(0.0508)
Constant	12.1191***	12.0753***	12.0540***
	(0.0230)	(0.0231)	(0.0206)
Observations	2,468,711	2,468,711	2,468,711
R-squared	0.5094	0.5096	0.5099
Bank-Time FE	YES	YES	YES
Borrower-Time FE	YES	YES	YES
Clusters	115	115	115

Notes: *Loan*, *All Suppliers* (*All Customers*) and *Number of Suppliers* (*Number of Customers*) are defined as in Table 1. All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

Table A.6- Baseline Model, breaking by firm size (based on money transfers data)

Panel A - Supplier and Borrower Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Dependent variable	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)
Firm size decile	All	1	2	3	4	5	6	7	8	9	10
Ln (All Suppliers)		0.0119***	0.0090***	0.0175***	0.0184***	0.0160***	0.0174***	0.0165**	0.0202***	0.0280***	0.0131*
		(0.0028)	(0.0032)	(0.0036)	(0.0036)	(0.0035)	(0.0038)	(0.0067)	(0.0060)	(0.0080)	(0.0071)
1st decile * Ln (All Suppliers)	0.0085**										
	(0.0035)										
2nd decile * Ln (All Suppliers)	0.0081										
	(0.0050)										
3rd decile * Ln (All Suppliers)	0.0121**										
	(0.0054)										
4th decile * Ln (All Suppliers)	0.0152***										
	(0.0035)										
5th decile * Ln (All Suppliers)	0.0152***										
	(0.0039)										
6th decile * Ln (All Suppliers)	0.0147***										
	(0.0033)										
7th decile * Ln (All Suppliers)	0.0180***										
	(0.0051)										
8th decile * Ln (All Suppliers)	0.0262***										
	(0.0060)										
9th decile * Ln (All Suppliers)	0.0347***										
	(0.0107)										
10th decile * Ln (All Suppliers)	0.0452***										
	(0.0150)										
Constant	11.9051***	11.5257***	11.4992***	11.4043***	11.4557***	11.6295***	11.7105***	11.9008***	12.0665***	12.4626***	13.9289***
	(0.0597)	(0.0152)	(0.0303)	(0.0423)	(0.0469)	(0.0483)	(0.0567)	(0.1046)	(0.0974)	(0.1385)	(0.1307)
Observations	1,533,554	131,425	151,520	155,111	155,503	154,864	155,381	155,722	156,241	157,090	159,120
R-squared	0.5115	0.4794	0.4578	0.4440	0.4536	0.4490	0.4519	0.4625	0.4656	0.4790	0.4934
Bank-Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Clusters	120	73	81	75	77	80	82	84	89	92	103

Table A.6 - Baseline Model, breaking by firm size (based on money transfers data) (cont.)

Panel B - Customer and Borrower Lending

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Dependent variable	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)	Ln (Loan)
Firm size decile	All	1	2	3	4	5	6	7	8	9	10
Ln (All Customers)		0.0018	0.0066**	0.0061*	0.0139***	0.0125***	0.0195***	0.0224***	0.0285***	0.0342***	0.0293***
		(0.0044)	(0.0028)	(0.0032)	(0.0018)	(0.0019)	(0.0029)	(0.0039)	(0.0059)	(0.0062)	(0.0068)
1st decile * Ln (All Customers)	0.0077										
	(0.0056)										
2nd decile * Ln (All Customers)	0.0097**										
	(0.0048)										
3rd decile * Ln (All Customers)	0.0089***										
	(0.0032)										
4th decile * Ln (All Customers)	0.0120***										
	(0.0037)										
5th decile * Ln (All Customers)	0.0120***										
	(0.0029)										
6th decile * Ln (All Customers)	0.0163***										
	(0.0026)										
7th decile * Ln (All Customers)	0.0212***										
	(0.0035)										
8th decile * Ln (All Customers)	0.0230***										
	(0.0049)										
9th decile * Ln (All Customers)	0.0355***										
	(0.0072)										
10th decile * Ln (All Customers)	0.0484***										
	(0.0107)										
Constant	11.9661***	11.4741***	11.4797***	11.5517***	11.5631***	11.6532***	11.7519***	11.9455***	12.1182***	12.5142***	13.7309***
	(0.0342)	(0.0106)	(0.0132)	(0.0227)	(0.0159)	(0.0197)	(0.0327)	(0.0492)	(0.0809)	(0.0951)	(0.1161)
Observations	1,510,663	139,354	147,299	150,315	152,276	152,389	152,590	152,358	151,757	154,212	156,412
R-squared	0.5114	0.4890	0.4621	0.4472	0.4386	0.4341	0.4427	0.4430	0.4473	0.4602	0.4817
Bank-Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Clusters	119	73	74	79	77	76	83	81	90	94	103

Notes: *Loan* and *All Suppliers* (*All Customers*) are defined as in Table 1; *firm size deciles* are defined based on the volume of money transfer sizes received by the firm in 2019. All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

Table A.7 - Cross-client Exposure by Decile

Panel A - All Suppliers' loans separated in bins

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)
All Suppliers - Decile 1	-0.0168	-0.0526**
	(0.0386)	(0.0211)
All Suppliers - Decile 2	0.0705	0.0320
	(0.0447)	(0.0237)
All Suppliers - Decile 3	0.0933*	0.0493
	(0.0544)	(0.0306)
All Suppliers - Decile 4	0.1587***	0.1047***
	(0.0552)	(0.0327)
All Suppliers - Decile 5	0.1874***	0.1188***
	(0.0548)	(0.0390)
All Suppliers - Decile 6	0.2482***	0.1550***
	(0.0530)	(0.0469)
All Suppliers - Decile 7	0.2363***	0.1153**
	(0.0626)	(0.0575)
All Suppliers - Decile 8	0.2531***	0.1095**
	(0.0569)	(0.0522)
All Suppliers - Decile 9	0.2435***	0.0792
	(0.0591)	(0.0589)
All Suppliers - Decile 10	0.2744***	0.0989
	(0.0771)	(0.0784)
[1 to 5 Suppliers]		0.0666***
		(0.0246)
[6 to 10 Suppliers]		0.1599***
		(0.0376)
[10 to 15 Suppliers]		0.2392***
		(0.0358)
[15 to 20 Suppliers]		0.2965***
		(0.0542)
[>20 Suppliers]		0.3682***
		(0.1273)
Constant	12.0788***	12.0528***
	(0.0188)	(0.0158)
Observations	2,912,963	2,912,963
R-squared	0.4989	0.4991
Bank-Time FE	YES	YES
Borrower-Time FE	YES	YES
Clusters	122	122

Table A.7 - Cross-client Exposure by Decile (cont.)

Panel B - All customers' loans separated in bins

VARIABLES	(1) Ln (Loan)	(2) Ln (Loan)
All Customers - Decile 1	0.0149	-0.0234
	(0.0523)	(0.0389)
All Customers - Decile 2	0.1110**	0.0581*
	(0.0446)	(0.0322)
All Customers - Decile 3	0.1222**	0.0608
	(0.0513)	(0.0400)
All Customers - Decile 4	0.1952***	0.1247***
	(0.0460)	(0.0421)
All Customers - Decile 5	0.2434***	0.1592***
	(0.0374)	(0.0397)
All Customers - Decile 6	0.2683***	0.1688***
	(0.0507)	(0.0501)
All Customers - Decile 7	0.2848***	0.1695***
	(0.0550)	(0.0557)
All Customers - Decile 8	0.2632***	0.1356***
	(0.0457)	(0.0369)
All Customers - Decile 9	0.2486***	0.1060**
	(0.0523)	(0.0456)
All Customers - Decile 10	0.2611***	0.0964
	(0.0759)	(0.0661)
[1 to 5 Customers]		0.0826***
		(0.0284)
[6 to 10 Customers]		0.2294***
		(0.0402)
[10 to 15 Customers]		0.3296***
		(0.0741)
[15 to 20 Customers]		0.3827***
		(0.1127)
[>20 Customers]		0.5358***
		(0.1286)
Constant	12.0931***	12.0553***
	(0.0092)	(0.0106)
Observations	2,912,963	2,912,963
R-squared	0.4989	0.4993
Bank-Time FE	YES	YES
Borrower-Time FE	YES	YES
Clusters	122	122

Notes: *Loan* is defined as in Table 1; *All Suppliers decile* (*All Customers decile*) is the decile of outstanding loan portfolio of all the firm´s suppliers (customers) at the same bank. All independent variables are measured with a one-year lag. We denote significance at 10%, 5%, and 1% with ∗, ∗∗, and ∗∗∗, respectively. Robust standard errors clustered at the bank level are reported in parentheses.

Table A.8 - Descriptive Statistics for Relationship Lending

Panel A - Raw data

The descriptive statistics below show the figures of each variable "as is": missing observations are *not* assigned to zero values.

	Unit	Mean	p25	p50	p75	sd	Observations
Borrower							
Bank Share of the Borrower	%	36.51	5.11	23.41	64.04	35.46	3,547,979
RelationYears of the Borrower	Years	11.17	3.44	8.67	16.57	9.66	3,574,987
Top 1 Supplier							
Bank Share of Top 1 Supplier	%	28.98	2.24	15.77	47.21	32.20	348,312
Bank Share of the Borrower * Top 1 Supplier	% * %	1201.11	12.10	226.92	1363.48	2095.79	345,380
RelationYears of the Top 1 Supplier	Years	25.38	10.26	28.55	39.07	14.36	348,312
RelationYears of the Borrower * Top 1 Supplier	Years * Years	408.61	47.97	213.52	678.91	458.75	348,312
Top 1 Customer							
Bank Share of Top 1 Customer	%	28.65	2.78	16.13	43.86	31.70	238,626
Bank Share of the Borrower * Top 1 Customer	% * %	1170.68	15.43	247.13	1310.25	2046.93	236,866
RelationYears of the Top 1 Customer	Years	23.38	8.37	26.01	37.20	14.52	238,626
RelationYears of the Borrower * Top 1 Customer	Years * Years	402.66	40.07	196.20	664.51	467.47	238,626

Panel B - Missing value assigned to zero

The descriptive statistics below show the figures of each variable assigned zero values when missing.

	Unit	Mean	p25	p50	p75	sd	Observations
Borrower							
Bank Share of the Borrower	%	36.51	5.11	23.41	64.04	35.46	3,547,979
RelationYears of the Borrower	Years	11.17	3.44	8.67	16.57	9.66	3,574,987
Top 1 Supplier							
Bank Share of Top 1 Supplier	%	2.82	0.00	0.00	0.00	13.22	3,574,987
Bank Share of the Borrower * Top 1 Supplier	% * %	116.92	0.00	0.00	0.00	744.54	3,547,979
RelationYears of the Top 1 Supplier	Years	2.47	0.00	0.00	0.00	8.76	3,574,987
RelationYears of the Borrower * Top 1 Supplier	Years * Years	39.81	0.00	0.00	0.00	187.58	3,574,987
Top 1 Customer							
Bank Share of Top 1 Customer	%	1.91	0.00	0.00	0.00	10.87	3,574,987
Bank Share of the Borrower * Top 1 Customer	% * %	78.16	0.00	0.00	0.00	604.24	3,547,979
RelationYears of the Top 1 Customer	Years	1.56	0.00	0.00	0.00	6.94	3,574,987
RelationYears of the Borrower * Top 1 Customer	Years * Years	26.88	0.00	0.00	0.00	157.12	3,574,987

Notes: *Bank Share of the Borrower*, *Bank Share of the Top 1 Supplier* (*Top 1 Customer*), *RelationYears of the Borrower* and *RelationYears of the Top 1 Supplier* (*Top 1 Customer*) are defined as in Table 3.

Table A.9 - Response to Top2, Top3, Top4, Top5 Supplier (or Customer) falling into arrears

Panel A - Top 2 Supplier or Customer

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Ln (loans) [BRL]		Int Rate [%]		Ln (duration) [years]	
Top2 Supplier in arrears	-0.0504		1.7988		-0.0402	
	(0.0688)		(1.8414)		(0.0285)	
Top2 Customer in arrears		-0.0914***		0.6645		-0.1187***
		(0.0331)		(1.2081)		(0.0160)
Constant	12.8686***	13.0197***	42.0523***	42.0648***	-0.7601***	-0.7921***
	(0.0080)	(0.0043)	(0.2123)	(0.1578)	(0.0033)	(0.0021)
Observations	91,713	74,700	75,078	59,327	91,713	74,700
R-squared	0.6201	0.6161	0.5119	0.5035	0.5444	0.5518
Bank-Time FE	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES
Clusters	45	54	43	46	45	54

Panel B - Top 3 Supplier or Customer

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Ln (loans) [BRL, winsorized]		Int Rate (winsorized, %)		Ln (duration) [years, winsorized]	
Top3 Supplier in arrears	-0.0282		2.6584*		0.0048	
	(0.0641)		(1.4753)		(0.0394)	
Top3 Customer in arrears		-0.0435		3.0820***		-0.0182
		(0.0265)		(1.1112)		(0.0348)
Constant	12.8616***	13.0923***	42.7905***	39.7008***	-0.7698***	-0.7734***
	(0.0076)	(0.0034)	(0.1717)	(0.1392)	(0.0047)	(0.0044)
Observations	83,213	68,546	67,734	54,887	83,213	68,546
R-squared	0.6114	0.6332	0.5221	0.4960	0.5507	0.5545
Bank-Time FE	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES
Clusters	50	50	50	50	50	50

Table A.9 - Response to Top2, Top3, Top4, Top5 Supplier (or Customer) falling into arrears (cont.)

Panel C - Top 4 Supplier or Customer

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Ln (loans) [BRL, winsorized]		Int Rate (winsorized, %)		Ln (duration) [years, winsorized]	
Top4 Supplier in arrears	-0.0590		6.0270***		-0.0248	
	(0.0579)		(1.2229)		(0.0380)	
Top4 Customer in arrears		0.0239		0.8103		-0.0465
		(0.0508)		(1.2867)		(0.0385)
Constant	12.9123***	13.0959***	42.1701***	40.8560***	-0.7692***	-0.8102***
	(0.0064)	(0.0064)	(0.1317)	(0.1598)	(0.0042)	(0.0049)
Observations	80,747	64,273	65,493	51,099	80,747	64,273
R-squared	0.6196	0.6212	0.5040	0.5026	0.5439	0.5456
Bank-Time FE	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES
Clusters	49	49	49	49	49	49

Panel D - Top 5 Supplier or Customer

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Ln (loans) [BRL, winsorized]		Int Rate (winsorized, %)		Ln (duration) [years, winsorized]	
Top5 Supplier in arrears	-0.2112***		4.3183***		-0.0796***	
	(0.0449)		(1.5139)		(0.0223)	
Top5 Customer in arrears		-0.1197**		-1.7261		-0.0402**
		(0.0469)		(1.9638)		(0.0162)
Constant	12.9053***	13.1629***	42.7581***	40.3557***	-0.7951***	-0.8004***
	(0.0048)	(0.0058)	(0.1595)	(0.2443)	(0.0024)	(0.0020)
Observations	74,723	59,905	60,360	48,028	74,723	59,905
R-squared	0.6195	0.6256	0.5147	0.5110	0.5430	0.5446
Bank-Time FE	YES	YES	YES	YES	YES	YES
Borrower-Time FE	YES	YES	YES	YES	YES	YES
Clusters	46	46	46	46	46	46

Notes: *Loan*, *Int. Rate (%)* and *Ln (duration)* are defined as in Table 5; *Top n Supplier in arrears* (*Top n Customer in arrears*) is an indicator that assumes value of 1 if firm i's top n supplier (or top n customer) has any loan falling into arrears for 14 days or more with the bank in a given quarter (but not in the previous quarter), and zero otherwise. We denote significance at 10%, 5%, and 1% with $*$, $**$, and $***$, respectively. *Post* is a dummy that assumes 1 in the four quarters that follow cohort *c* and 0 in the four quarters preceding it. Robust standard errors clustered at the bank level are reported in parentheses.