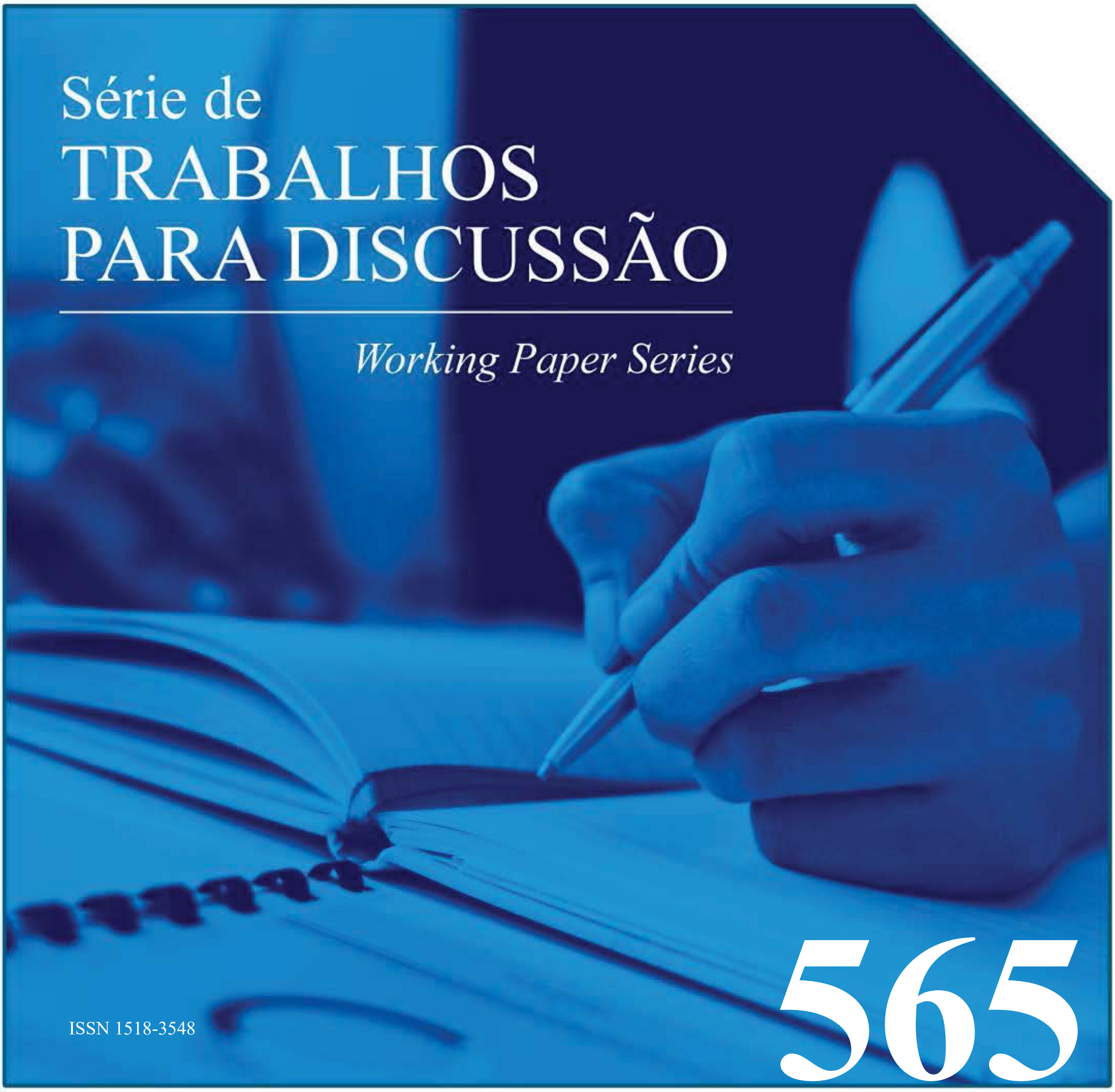

August 2022

Lending Relationships and Currency Hedging

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BANCO CENTRAL DO BRASIL

ISSN 1518-3548
CGC 00.038.166/0001-05

Working Paper Series	Brasília	no. 565	Agosto	2022	p. 3-66

Working Paper Series

Edited by the Research Department (Depep) – E-mail: workingpaper@bcb.gov.br

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Non-technical Summary

Firms may suffer negative consequences when they are exposed to foreign exchange (FX) fluctuations, such as a decrease in investments, lower stock prices and worsening financial conditions. Buying over-the-counter (OTC) derivatives from banks is one popular strategy of non-financial firms to hedge these risks.

In this paper, we examine the role of bank lending relationships in the access to FX hedging and its cost for non-financial firms. To accomplish this task, we put together a novel dataset, which combines detailed information on FX OTC derivatives transactions and loan-level data.

We find that firms are more likely to buy FX OTC derivatives from one of their lenders than from a non-lending bank. The probability of a match between a firm and a bank is higher when the bank is the firm's main lender, suggesting that the intensity of the relationship matters. Intensity also matters for the pricing of OTC derivatives: firms get better prices from their main lender. All of these effects are stronger for small firms.

Taken together, these results show that previous lending relationships reduce the hurdles to hedge using FX OTC derivatives, particularly for small firms.

The main academic contribution of this study is to be the first to look into lending relationships and hedging provision for firms, an issue largely overlooked by the literature on hedging risk, relationship lending, and cross-selling.

This work provides academic support for policies that increase competition among financial institutions and reduce information asymmetries. Initiatives of information sharing mechanisms, such as open banking/finance, expand the information set available to institutions that have no lending relationship with a potential customer. Our results suggest that these policies may increase the number of institutions offering favorable conditions for firms willing to hedge their FX exposures and could eventually reduce the chance of financial woes.

Sumário Não-técnico

Empresas com exposição cambial podem sofrer várias consequências negativas tais como diminuição de investimentos, preços de ações mais baixos e piora de condições financeiras. Os derivativos de balcão (OTC, do termo em inglês over-the-counter) vendidos pelos bancos são instrumentos financeiros bastante procurados por empresas não financeiras para fazer hedge. Neste artigo, examinamos o papel do relacionamento de crédito entre bancos e empresas não financeiras no acesso a derivativos cambiais de balcão. Para realizar essa tarefa, construímos uma base de dados inédita que combina informações granulares de transações de derivativos cambiais de balcão e de operações de crédito. Os resultados mostram que é mais provável uma empresa comprar derivativos cambiais de bancos com quem tem operações de crédito do que de outros bancos. A probabilidade de a empresa comprar do banco que é seu principal emprestador é ainda maior, sugerindo que a intensidade do relacionamento é relevante. A intensidade também é relevante para a precificação dos derivativos: os preços são menores quando as empresas transacionam com o seu principal emprestador. Todos esses efeitos são mais fortes para as pequenas empresas. Tomados em conjunto, esses resultados mostram que relacionamentos bancários de crédito reduzem obstáculos ao hedge por meio de derivativos cambiais de balcão, principalmente para pequenas empresas. A principal contribuição acadêmica deste estudo é ser o primeiro a tratar do tema relacionamento de crédito e provisão de hedge para empresas, uma questão amplamente ignorada pelas literaturas de gerenciamento de risco, de relacionamento bancário, e de venda cruzada. Este trabalho fornece suporte acadêmico a políticas que aumentem a competição entre as instituições financeiras e reduzam as assimetrias de informação. Iniciativas de criação de mecanismos de compartilhamento de informações, como o open banking/finance, visam ampliar o conjunto de dados disponíveis para instituições financeiras que não possuem relacionamento de crédito com um potencial cliente. Nossos resultados sugerem que essas políticas podem aumentar o número de instituições que oferecem condições competitivas a empresas que desejem proteger exposições cambiais, o que pode reduzir a chance de problemas financeiros dessas empresas.

Lending Relationships and Currency Hedging

Sérgio Leão, Rafael Schiozer, Raquel F. Oliveira, and Gustavo Araujo*

Abstract

Firms' currency exposure may result in financial distress and trigger macroeconomic instability. Such exposure can be hedged using currency over-the-counter derivatives. We investigate whether and how lending relationships affect the access to these derivatives using novel loan and derivatives microdata. We document that firms are more likely to buy derivatives from one of their lenders than from a non-lending bank. We also find that prices are lower for derivatives provided by the main lender. These results are stronger among small firms. Our findings are consistent with lending relationships mitigating information asymmetries and derivatives reducing a bank's loan portfolio risk.

JEL Classification: G21, G32, F31, G13.
Keywords: currency hedging, FX market, hedging costs, lending relationship.

1 Introduction

Unhedged foreign exchange (FX) liabilities on firms' balance sheets are a major channel precipitating the negative macroeconomic consequences of currency depreciation events.[1] The

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[1] The seminal works of Krugman (1999), Caballero and Krishnamurthy (2003), and Céspedes, Chang, and Velasco (2004) introduce the balance sheet effects. Gopinath and Stein (2021) and Eren and Malamud (2022) highlight the dominant role of the dollar along several dimensions, such as invoicing in international trade, bank funding, corporate borrowing, and holding Central Bank reserves. Further, see Salomao and Varela (2022) for a recent theoretical and empirical analysis on firms' currency debt composition and investment choices.

consequences at the firm level include deteriorating financial conditions (Alfaro et al., 2019; Niepmann and Schmidt-Eisenlohr, 2022), underinvestment (Caballero, 2021), and stock price decline (Bruno and Shin, 2020). The access of firms to derivatives instruments is a key element for mitigating the detrimental impacts of currency fluctuations by reducing firms' costs of financial distress and ensuring that they have the funds to invest in profitable projects.[2] Evidence from surveys and administrative data show that firms predominantly rely on over-the-counter (OTC) derivatives provided by financial institutions to hedge risk, both in developed and emerging economies.[3] Nevertheless, most of the literature is silent about the role of financial institutions in providing these derivatives.

Our study focuses on the role of banks in providing FX OTC derivatives to non-financial firms. Specifically, we investigate whether the breadth and depth of lending relationships affect access to these derivatives. To guide our analysis, we revisit the theory of relationship banking.[4] Like loans, derivatives carry credit risk to the banks that provide them through OTC markets. Similarly, the decision to supply these instruments – and at what price – relies heavily on the ability to screen and monitor counterparties. Along the lines of Bharath et al. (2007), it is reasonable to conjecture that the cost of assessing the credit risk of a derivatives trade is lower when the bank has already screened and has been monitoring the firm because of an active lending relationship. Additionally, a lender (termed a "lending relationship bank" hereinafter) may create incentives for its borrowers to hedge their FX exposure and mitigate the credit risk of its own loan portfolio. For these reasons, a firm may receive more favorable terms in OTC derivatives contracts from lending relationship banks than from other banks with which it does not have a pre-existing lending relationship (termed non-lending banks hereinafter). On the demand side, firms may

[2]For well-established theories explaining how financial hedging with derivatives may mitigate these problems, see Smith and Stulz (1985) and Froot, Scharfstein, and Stein (1993). Gilje and Taillard (2017) and Jankensgård and Moursli (2020) provide empirical evidence supporting these theoretical predictions.

[3]For instance, Bodnar et al. (2011) show that using derivatives instruments is the most frequent strategy adopted to hedge currency exposure and 66% of non-financial firms declare using "only OTC" or "mostly OTC" derivatives for hedging. Bartram (2019) provides recent evidence on the use of FX derivatives for hedging purposes, and Alfaro, Calani, and Varela (2021) present a comprehensive analysis on the use of FX derivatives for hedging in Chile. Upper and Valli (2016) show that the median derivatives turnover in emerging market economies represents 5% of annual GDP compared with 20% in advanced economies. They document the same pattern for FX derivatives turnover set against foreign trade measures.

[4]See Kysucky and Norden (2016) for a meta-analysis of the relationship lending literature.

prefer buying derivatives from their lenders instead of incurring the transaction costs of opening a new bank account. However, lending relationship banks may "lock in" their clients (Kanatas and Qi, 2003) and extract additional rents from them, as shown by Ioannidou and Ongena (2010). Hence, it is an empirical issue to determine whether firms benefit from their lending relationships, or whether lending relationship banks exploit their informational advantage to extract rents when trading OTC derivatives.

For our empirical analysis, we build a novel dataset combining bank loan and OTC derivatives contract information in Brazil. The focus on Brazil aids our investigation because, arguably, access to hedging is more restricted in emerging market economies. Lower financial system development, higher volatility, and the carry costs associated with high interest rate differentials raise the cost of hedging against currency depreciation in these economies (Koijen et al., 2018; Brunnermeier, Nagel, and Pedersen, 2008).

We merge several unique datasets that combine information on FX OTC derivatives, bank loans, and employment data for all Brazilian firms that traded OTC derivatives between 2010 and 2014. Our data on OTC derivatives include detailed contract-level information on all the FX derivatives traded between firms and financial institutions in the OTC market. Our loan-level data allow us to identify both the existence and intensity of the lending relationships between the firms in our sample and all banks operating in the country. This feature allows us to exploit the differences in the intensity of the relationship by computing the length of the firm–bank lending relationship, and measuring how much of a firm's borrowing comes from each bank (termed the concentration of lending), thereby identifying the firm's main lender.

We start by analyzing the interplay between the lending relationship and access to the derivatives market. We find that, on average, for every \$100 in the notional value of FX OTC derivatives traded by the firm, \$36 comes from the firm's main lender, \$44 comes from other lenders, and only \$20 is provided by non-lending banks. Combining all the firms and banks that trade FX OTC derivatives on a given day, we assess whether the matching probability is higher for lending relationship bank–firm pairs. Our results show that the probability of a firm buying a derivative from a lending relationship bank is 10 percentage points higher than from a non-lending bank on average. Additionally, the likelihood of a firm trading with its main lender is twice as large. The inferences are similar when we use the concentration of lending and length of the lending relationship as alternative measures of relationship intensity. Since we use bank-day fixed effects, our results are robust to controlling for the within bank-day supply of derivatives.

We further find that these effects are stronger among small firms. The existence of lending relationships for small firms yields an increase in the matching probability that is at least 60% larger than that for other firms. These results are in line with previous findings that the lending relationship technology operates mainly by solving the information asymmetry problems that are more pronounced for small firms (Berger and Udell, 1995; Bharath et al., 2011).

Next, we investigate whether firms are granted lower-priced FX derivatives by their lending relationship banks. To make this comparison possible, we restrict our analysis to plain vanilla non-deliverable forward (NDF) contracts that exchange Brazilian Reals (BRL) against US dollars (USD).[5] Our price measure is the spread between the agreed forward exchange rate and the exchange rate of same maturity future contracts traded at B3 (the Brazilian stock and derivatives exchange). We analyze within-firm variation in spreads by focusing on firms that trade NDFs in the same quarter with both lending relationship and non-lending banks. We find that a more intense lending relationship yields a significantly lower spread. The firm's main lender charges a spread that is 3 basis points lower than that of other banks on average, which represents around 30% of the average sample spread. We further find that the spread reduction is even more pronounced for small firms, which is consistent with the hypothesis that an intense bank relationship reduces the problem of asymmetric information and benefits more opaque firms.

Next, we investigate whether lending relationships affect other contractual terms. For the identification, we again analyze firms that trade FX OTC derivatives in the same quarter with both lending relationship and non-lending banks. We test whether firms trade larger notional amounts or longer maturity derivatives with lending relationship banks than with other banks. For this group of firms, we find no evidence that they trade different notional amounts or different

[5]A plain vanilla NDF is a contract that obliges each counterparty to exchange USD for BRL at a pre-specified exchange rate, agreed when the contract is traded. NDFs are normally settled in the domestic currency (*i.e.*, in BRL) by the difference between the contractual NDF rate and the spot rate at maturity.

maturities with lending relationship banks. Nevertheless, we find weak evidence that non-lending banks provide a larger share of customized derivatives contracts for small firms than lending relationship banks.

Overall, our results show that pre-existing lending relationships mitigate the barriers to hedging using FX OTC derivatives, particularly for small firms. They support the hypothesis that lending relationship banks have an advantage over non-lending banks due to information that has previously been acquired from their loan contracts and that firms' derivatives usage may help reduce banks' loan portfolio risk.

Our study adds to the literature across several dimensions. Our main contribution is that we show the relevance of lending relationships for accessing currency derivatives, thus linking the theories of relationship banking theory and corporate hedging. Most of the literature on corporate hedging (Froot, Scharfstein, and Stein, 1993; Géczy, Minton, and Schrand, 1997; Allayannis and Ofek, 2001; Rampini and Viswanathan, 2010; Rampini and Viswanathan, 2013; Bartram, 2019) focuses on the determinants and consequences of using derivatives, but the role of financial intermediaries in providing derivatives has been largely overlooked. We show that both the existence and intensity of the lending relationship increase the probability of trading derivatives with that bank, particularly for small (opaque) firms. Additionally, we document that the main lender charges a lower price for NDF contracts.

These results are consistent with the argument that both firms and their lending relationship banks benefit when they trade FX OTC derivatives. Lending relationships reduce the costs of information acquisition because the firm is already screened and monitored. Lending relationship banks benefit from reducing their borrowers' credit risk when offering FX OTC derivatives for hedging and from increasing the range of products traded, taking advantage of economies of scope. Consequently, firms' access to derivatives improves.

Further, we contribute to the literature on the relation between hedging and firms' credit risk. Chen and King (2014) provide evidence that corporate hedging is associated with a lower cost of debt by reducing bankruptcy risk and the level of information asymmetry. Campello et al. (2011) investigate the implications of hedging for corporate financing –particularly for private credit agreements – and document that hedging lowers the true cost of debt and that the effect is stronger for firms near distress or more likely to engage in risk-shifting. In this regard, we contribute to the field by examining the reverse channel; that is, instead of examining how hedging reduces the cost of debt, we show that having an intense lending relationship facilitates firms' access to the derivatives market and lowers their cost of hedging. These findings suggest that lending relationship banks offer derivatives with more favorable terms because firm's hedging improves the value of loans, consistent with Bessembinder (1991).

Finally, this study contributes to the literature on bank relationships and cross-selling. According to Bharath et al. (2007), the establishment of a lending relationship gives a bank an informational advantage in terms of selling other fee-generating services. Additionally, Santikian (2014) claims that when providing loans to their clients, banks maximize their profit compared with the other financial services offered to borrowers. The relevance of scope economies due to information production synergies has been documented in studies that relate checking account activities and lending decisions (Mester, Nakamura, and Renault, 2007; Norden and Weber, 2010), bank cross-account information (e.g., deposit, investment, and loan accounts) and the management of credit card accounts (Agarwal et al., 2018; Hibbeln et al., 2020), and lending relationship and underwriting services (Drucker and Puri, 2005; Bharath et al., 2007; Puri and Rocholl, 2008). We present novel evidence on the cross-selling synergy between lending relationships and the provision of hedging services due to the acquisition of private information and possible risk reduction of the loan portfolio.

The remainder of the paper is organized as follows. In Section 2, we describe the data and present a descriptive analysis. In Section 3, we present our econometric strategy and main empirical findings. In Section 4, we conclude.

2 Data and Descriptive Analysis

2.1 Data

We use five datasets. Our first dataset contains contract-level data on all OTC currency derivatives traded between banks and non-financial firms in Brazil. Our analyses cover the period between January 2010 and December 2014, for which we were able to access detailed information on derivatives contracts and match them to firms' loan-level data. These data are reported by B3,[6] the central clearinghouse for these instruments, to the Central Bank of Brazil (BCB). We describe this dataset in more detail in Section 2.2.

The second dataset is the Credit Information System (SCR, acronym in Portuguese), a credit registry held and managed by the BCB. This dataset contains monthly loan-level information on all the loans granted by banks in Brazil. For each loan, we identify the firm-bank pair, firm industry, loan approval date, loan amount outstanding, type of loan, loan currency, and firm's account opening date.[7]

The third dataset contains daily information on exchange-traded BRL–USD future contracts provided by B3 (the largest Brazilian exchange for derivatives). We use this information to compute the spread between the forward and future exchange rates. The spread is calculated as the percentage difference between the forward exchange rate of the NDF and exchange rate of the exchange-traded future contract of the same maturity. When the maturity of the NDF does not match exactly an existing maturity for the future contract, we use a cubic spline interpolation using the existing maturities of the future contract prices.

The fourth dataset is the Annual Social Information System (RAIS, acronym in Portuguese), a mandatory survey filled out by all tax-registered firms in Brazil. This dataset is owned and managed by the Brazilian Ministry of Labor. For each firm-year, we are able to identify the

[6] B3 was formed in March 2017 by the merger of BM&F–Bovespa, which was the major Brazilian stock and derivatives exchange, with Cetip, the central securities depository and clearinghouse in Brazil. Since 2009, all OTC derivatives contracts negotiated in Brazil (including currency NDFs, swaps, and options) have had to be registered at Cetip (currently B3).

[7] The Credit Information System as well as the derivatives data reported by B3 are confidential datasets of the Central Bank of Brazil. Since the loan value regulatory threshold above which banks are required to report detailed information on loans is particularly low –never set above BRL 5000 (approximately USD 2000 as of December 2014) – our dataset contains virtually all the loans made to non-financial firms in Brazil.

end-of-year number of employees, which we use as a proxy for firm size.

Finally, our fifth dataset is the import/export register of the Brazilian Ministry of Industry, Foreign Trade and Services. It contains information on whether a firm has any export or import activity in each year.

2.2 FX Derivatives Market in Brazil

The Brazilian economy has been operating under a floating exchange rate regime since 1999, meaning that the BCB does not determine the exchange rate level in currency markets. As in other emerging markets, the exchange rate presents substantial volatility, and currency risk is one of the largest sources of financial risk for non-financial firms in the country (Chui, Fender, and Sushko, 2014).

We focus on the FX OTC derivatives traded between non-financial firms and financial institutions,[8] as we are interested in the role of financial intermediaries on firms' access to hedging instruments and cost of hedging. The vast majority of the FX OTC derivatives are NDF contracts, which account for 85% of the total notional value traded between banks and firms in our sample.

Local currency depreciation events pose more severe consequences to emerging market economies than currency appreciation shocks, both during crises (Kalemli-Ozcan, Kamil, and Villegas-Sanchez, 2016; Aguiar, 2005; Kim, Tesar, and Zhang, 2015) and in normal times (Caballero, 2021; Alfaro et al., 2019; Bruno and Shin, 2020). Indeed, assets denominated in a strong currency, such as USD, work as an insurance for domestic investors because local currencies tend to depreciate under unfavorable macroeconomic conditions in emerging markets (Brunnermeier, Nagel, and Pedersen, 2008; Mancini, Ranaldo, and Wrampelmeyer, 2013). This phenomenon is related to the concept of carry (Koijen et al., 2018).

In the case of Brazil, the large interest rate differential turns BRL into a carry currency, and consequently, the forward exchange rate, obtained by non-arbitrage (i.e., covered interest rate parity), is a biased estimate of the exchange rate in the future, meaning that firms willing to

[8] The Brazilian banking system comprises mostly universal banks that are allowed offer a wide range of financial products, meaning that virtually all financial institutions are allowed to offer loans and derivatives products to non-financial firms.

hedge imports bear the cost of the currency premium upon hedging (Engel, 2016). This implies that their hedging contracts exhibit negative expected returns ex-ante because of the currency premium (on top of any premium for counterparty credit risk), and even more so when exchange rate volatility is high.[9] In other words, when hedging their exposure to a foreign currency, Brazilian importers or firms with foreign liabilities must pay the carry premium, whereas firms with long exposure to FX variations (e.g., exporters) earn the carry premium when hedging their exports or FX assets, meaning that derivatives contracts that are short in the USD exhibit positive expected returns.[10] Further, firms with long exposure to foreign currency have efficient alternatives other than using derivatives for hedging.[11] We restrict our analysis to firms that take long positions in the foreign currency (and short in the BRL) in derivatives contracts, which is typical of firms willing to hedge foreign-denominated liabilities (*e.g.*, importers). In our sample, such positions are adopted by 6342 firms, and such contracts are provided by 53 banks.

Table 1 summarizes the data at the firm level. Both the number of employees and firm's age exhibit right-skewed distributions, revealing the dominance of relatively small and young firms in our sample. For small and young firms, access to the FX OTC derivatives market may be a relevant issue. Although approximately 66% of the firms in our sample are importers[12] and 38% are exporters, the notional value of derivatives transactions are smaller than the firms' loan amount outstanding. We compute the derivatives ratio measure as the proportion of the firm's FX derivatives outstanding amount with respect to its total banking services.[13] We use the sum of FX derivatives outstanding and total loan amount outstanding as a proxy of total banking services, which allows us to compare the relevance of FX derivatives with that of firm borrowing.

[9] See Engel (2014) for a comprehensive survey on the determination of nominal exchange rates, including the deviation from uncovered interest parity and existence of the FX risk premium.

[10] Additionally, the appreciation of the domestic currency is frequently of small magnitudes and associated with carry trade episodes (Mancini, Ranaldo, and Wrampelmeyer, 2013; Brunnermeier, Nagel, and Pedersen, 2008; Menkhoff et al., 2012).

[11] Exporters, for instance, may hedge their FX exposure when they raise working capital by borrowing in a foreign currency and providing their export contracts as collateral. For example, the outstanding volume of export-linked loans as of December 2014 was BRL 110 billion, or USD 41 billion, (Banco Central do Brasil, 2018, p. 9), while the overall notional value of the short USD derivatives positions of non-financial firms was USD 52 billion on the same date.

[12] A firm that does not engage in imports directly may still be exposed to currency fluctuation if it has foreign debt or if the prices of its inputs vary according to the exchange rate.

[13] Both the FX derivatives outstanding amounts and total banking services are aggregate measures at the firm level, which include all the banks that provide these services to the firm.

Table 1: Summary statistics at the firm level

	Obs	Mean	Std.Dev.	Q1	Median	Q3
Number of employees	6167	684.67	2765.15	31.00	121.00	397.00
Firm's age (months)	6160	246.15	162.14	117.00	205.00	358.00
Importer (dummy)	6342	0.67	0.47	0.00	1.00	1.00
Exporter (dummy)	6342	0.39	0.48	0.00	0.00	1.00
Derivatives ratio	6280	0.06	0.18	0.00	0.00	0.02
NDF-to-total derivatives ratio	6342	0.65	0.42	0.14	0.95	1.00
Derivatives share with relationship banks	6342	0.80	0.34	0.70	1.00	1.00
Derivatives share with the main bank	6342	0.36	0.42	0.00	0.11	0.99
Maturity (days)	6342	271.42	306.56	89.00	177.00	359.00
Notional (USD million)	6342	3.24	13.94	0.15	0.47	1.65

Notes: This table summarizes the data at the firm level from January 2010 to December 2014. We compute the number of employees and firm's age (measured in months) as the median values over the sample period. The derivatives ratio is the proportion of FX derivatives outstanding with respect to the sum of FX derivatives' notional value and loan amount outstanding. The NDF-to-total derivatives ratio is the ratio of the notional value of FX NDF contracts to the total FX OTC notional amount traded between the firm and all the banks in the sample period. The derivatives share with lending relationship banks and derivatives share with the main bank are, respectively, the share of the FX OTC notional amount traded with all relationship banks and with the main bank in the sample period. A lending relationship bank is a bank with which the firm had any outstanding loan balance in the previous 12 months and the main bank is the bank among the relationship banks with which the firm maintained the largest lending outstanding balance in the previous 12 months.

Indeed, FX derivatives transactions represent only 6% of all banking services for the average firm.[14] For at least three-quarters of the sample firms, their FX derivatives represent less than 2% of their banking services. Given the relevance of lending products with respect to derivatives, we argue that most information costs are related to granting and renewing loans. Therefore, the existence of a lending relationship implies that the bank has incurred fixed information gathering costs for an appropriate risk assessment before pricing OTC derivatives. These sunk information costs are especially relevant for more opaque firms negotiating a small notional amount of FX derivatives products and may be a determinant of their access to the derivatives market.

For at least 50% of the firms in our sample, all their derivatives transactions are traded with lending relationship banks (*i.e.*, with banks from which they had a loan outstanding in the previous 12 months). For the average firm in our sample, 80% of its notional value in FX derivatives is negotiated with relationship banks. The intensity of lending relationship is also relevant. For one-quarter of the firms in our sample, 99% or more of their FX derivatives notional value is traded with their main bank (*i.e.*, the bank with which the firm maintained the largest loan outstanding balance among lending relationship banks in the previous 12 months). On average, 36% of firms' FX derivatives is traded with their main bank. This preference for relationship banks occurs mainly when firms demand simpler types of derivatives, such as NDF contracts. Indeed, for 50% of the firms, NDF contracts account for 95% or more of their notional amount in FX OTC derivatives. On average, approximately two-thirds of FX OTC derivatives are NDF contracts, which are usually short-term contracts. As the forward rate is agreed upon at the contract date, those plain vanilla products are easily priced and banks usually keep a bid-ask spread on those products. Therefore, price discrimination according to firm characteristics in NDF contracts should be considered significant in two broad cases: i) for more opaque firms, as the cost of assessing of their creditworthiness may be higher than to the bid–ask spread, and ii) for firms with which the lending relationship bank intends to increase the amount of products sold.

[14] This is the only case in which we compute the notional amount in BRL to have the same unit for loans and derivatives. For all the other derivatives measures, the currency of the notional amount is USD.

Table 2: Comparing low frequency firms with other firms.

	Low Frequency Firms				Other Firms				Diff
	Obs	Median	Mean	Std.Dev.	Obs	Median	Mean	Std.Dev.	
Number of employees	2937	82.00	389.89	1795.37	3230	177.25	952.71	3393.95	562.82***
Firm's age (months)	2936	193.00	228.80	154.12	3224	217.50	261.95	167.58	33.15***
Importer (dummy)	3061	1.00	0.54	0.50	3281	1.00	0.79	0.41	0.24***
Exporter (dummy)	3061	0.00	0.28	0.45	3281	0.50	0.49	0.49	0.21***
Derivatives ratio	3000	0.00	0.01	0.07	3280	0.01	0.11	0.23	0.10***
NDF-to-total derivatives ratio	3061	1.00	0.62	0.45	3281	0.92	0.68	0.39	0.06***
Derivatives share with relationship banks	3061	1.00	0.85	0.34	3281	0.94	0.75	0.33	-0.10***
Derivatives share with the main bank	3061	0.00	0.44	0.48	3281	0.12	0.29	0.35	-0.16***
Maturity (days)	3061	209.00	337.75	341.15	3281	136.59	209.53	255.29	-128.22***
Notional (USD million)	3061	0.35	2.21	10.45	3281	0.71	4.21	16.49	1.99***

Notes: This table summarizes the data at the firm level from January/2010 to December/2014. Low frequency firms are those that trade derivatives in only one quarter of the sample. We compute the number of employees and firm age (measured in months) as the median values along the sample period. The derivatives ratio is the proportion of FX derivatives outstanding with respect to the sum of FX derivatives notional value and loan amount outstanding. The NDF-to-total derivatives ratio is the ratio of the notional value of FX NDF contracts with respect to the total FX OTC notional amount traded between the firm and all the banks in the sample period. The derivatives share with relationship banks and derivatives share with the main bank are respectively the share of the FX OTC notional amount traded with all lending relationship banks and with the main bank in the sample period. A lending relationship bank is a bank with which the firm had any outstanding loan balance in the previous 12 months and the main bank is the bank among the relationship banks with which the firm maintained the largest lending outstanding balance in the previous 12 months. The last column shows the mean difference between low frequency firms and other firms for each variable.

Another important aspect of the FX OTC derivatives market for our analysis is related to how often a firm trades FX OTC derivatives. If the access to the derivatives market is restricted, one would expect that a significant number of firms would enter the market only sporadically. Indeed, 3061 (47%) of the firms in our sample trade derivatives in only one quarter from 2010 to 2014 (we call these low frequency firms).

Table 2 shows the difference between low frequency firms and other firms. Low frequency firms are smaller, younger, and less engaged in international trade on average. In other words, they are more opaque than other firms. According to the hypothesis that lending relationship banks facilitate access to derivatives markets due to their previous private information acquisition, one would expect low frequency firms to rely more on lending relationship banks, particularly on their main relationship bank. For firms that use derivatives infrequently, the costs of searching for a new (*i.e.*, non-lending) bank to provide derivatives may be too high, as these costs are not diluted through several interactions. Therefore, infrequent firms may be more prone to resort to their lending relationship banks for derivatives. In fact, for low frequency firms, compared to other firms, the share of FX derivatives traded with relationship banks is 10 percentage points (or 13%) higher and the share of derivatives traded with the main bank is more than 50% larger than for other firms. All the differences are statistically significant at the 1% level.

In the remainder of this section, we split the sample according to firm size in order to examine whether small firms rely more on relationship banks than large firms when it comes to buying FX derivatives. We follow the EU Recommendation 2003/361 and classify firms with no more than 250 employees as small firms. Table 3 shows the differences between small and large firms in our sample. Small firms – compared to large firms – are younger, less engaged in international trade, have a lower derivatives share, and rely more on relationship banks for derivatives. Small firms use simpler derivatives products: the average NDF-to-derivatives ratio is 70%, compared to 56% for large firms. Small firms also rely more on their lending relationship banks for FX derivatives than large firms do. Further, the share of derivatives traded with the main bank is 17 percentage points higher than that for other firms, suggesting that the intensity of lending relationship is also determinant for the access of small firms to derivatives.

Table 3: Comparing small and large firms

	Small Firms				Other Firms				Diff
	Obs	Median	Mean	Std.Dev.	Obs	Median	Mean	Std.Dev.	
Number of employees	4069	51.00	74.13	68.41	2098	692.50	1868.79	4510.79	1794.66***
Firm's age (months)	3963	181.50	212.32	141.93	2026	310.00	322.84	172.83	110.52***
Importer (dummy)	4069	1.00	0.64	0.48	2098	1.00	0.73	0.44	0.09***
Exporter (dummy)	4069	0.00	0.31	0.46	2098	1.00	0.57	0.49	0.26***
Derivatives ratio	4028	0.00	0.05	0.17	2080	0.01	0.08	0.20	0.03***
NDF-to-total derivatives ratio	4069	1.00	0.70	0.41	2098	0.69	0.56	0.43	-0.15***
Derivatives share with relationship banks	4069	1.00	0.82	0.34	2098	0.98	0.76	0.33	-0.07***
Derivatives share with the main bank	4069	0.20	0.41	0.44	2098	0.03	0.24	0.35	-0.17***
Maturity (days)	4069	176.00	247.45	264.60	2098	180.01	319.78	374.29	72.33***
Notional (USD million)	4069	0.34	1.46	6.77	2098	1.33	6.70	21.79	5.25***

Notes: This table summarizes data at the firm level along the period from January/2010 to December/2014. Small firms are those with no more than 250 employees. We compute the number of employees and firm age (measured in months) as the median value along the sample period. The derivatives ratio is the proportion of FX derivatives outstanding with respect to the sum of FX derivatives' notional value and loan amount outstanding. The NDF-to-total derivatives ratio is the ratio of the notional value of FX NDF contracts to the total FX OTC notional amount traded between the firm and all the banks in the sample period. The derivatives share with relationship banks and derivatives share with the main bank are respectively the share of the FX OTC notional amount traded with all relationship banks and with the main bank in the sample period. A lending relationship bank is a bank with which the firm had any outstanding loan balance in the previous 12 months and the main bank is the bank among the relationship banks with which the firm maintained the largest lending outstanding balance in the previous 12 months. The last column shows the mean difference between small firms and large firms for each variable.

To alleviate the concern that these differences could be driven by firms that trade derivatives infrequently, we separately analyze the group of firms that traded derivatives in only one quarter during our sample period (i.e., low frequency firms). Table A1 in Appendix A compares small firms to large firms for the subsample of low frequency firms. In Table A2 , also reported in Appendix A, we analyze the subsample of high frequency firms (i.e., those that trade derivatives in more than one quarter of our sample period) and again compare small firms with other firms. We find that the differences between small and large firms are qualitatively similar for low and high frequency firms.

3 Empirical Analysis

In this section, we test whether firms' unconditional preference for relationship banks previously described persists after controlling for a set of variables and conditions. The major concern about making inferences from our descriptive results is selection bias. More productive and less risky firms may self-select themselves into large and more complex banks that take advantage of economies of scope and scale to provide both credit and derivatives to these better firms. In such a setting, disentangling the relevance of the bank relationship from the effect of firms' and banks' characteristics on the choice of derivatives supplier would be difficult.

The ideal experiment to identify the effect of the lending relationship on the choice of derivatives supplier would require i) identical firms to be randomly assigned to identical banks, with which they engage in a lending relationship; and ii) some source of exogenous variation in demand for FX derivatives across firms. After being exposed to the same derivatives' demand shock, firms receive derivatives quotations from both their lending relationship bank and another non-lending bank. The relevance of the pre-existing lending relationship on derivatives terms could be inferred by computing the difference between the contract terms offered by the lending relationship bank and non-lending bank.

As there is no such natural experiment, our main empirical strategy exploits firms' and banks' within variation (*i.e.*, using firm and bank fixed effects). Therefore, our empirical methodology aims to test whether differences in the lending relationship imply better contractual terms for derivatives once we control for time varying firms' and banks' unobserved characteristics. We also control for the firm's demand for derivatives, as we compare observations of the same firm trading with different banks in the same quarter by employing firm-quarter fixed effects. In the same way, we control for each bank's supply of derivatives by employing bank-day or bank-quarter fixed effects. In addition, to address the possible concerns that better firms are endogenously related to better banks, we use bank-firm fixed effects in robustness checks. Our robustness checks (described in detail further in the text) also suggest that reverse causality (i.e., derivatives relationship causing lending relationship) is implausible and our variables do not seem to suffer from any relevant measurement error. Nonetheless, even if one believes that the lack of exogenous variation in bank-to-firm lending prevents us from precisely gauging the causal effect of lending relationships on the access to derivatives and the cost of hedging, our empirical approach still allows us to assess whether banks provide preferential access to OTC derivatives to their borrowers. Unveiling the role of financial intermediaries in providing hedging to firms is relevant, particularly in an environment with high hedging costs.

We split our empirical analysis into three main subsections, as we explore different samples and data frequencies to understand the main aspects of firms' use of derivatives. We start by assessing whether the matching probabilities between a firm and bank in the derivatives marketplace are influenced by their lending relationship. To do so, we use daily data on all the FX derivatives in our sample. Next, we restrict the data to plain vanilla NDF contracts on a daily basis and test whether firms are charged a lower price by their lending relationship banks than by other banks. Finally, we use firm–bank quarter aggregated data on all types of FX derivatives to test whether firms negotiate larger notional amounts of derivatives and a longer maturity with their relationship banks than with other banks.

3.1 Matching Probabilities

Our descriptive analysis presented in Section 2.2 shows that firms trade FX derivatives mostly with their lending relationship banks. However, this association might stem simply from bank size (*i.e.*, larger banks are more likely to provide loans and derivatives) or other bank-specific features unrelated to the existence of lending relationship. To properly examine in detail whether a firm is more likely to be granted a derivatives contract by a lending relationship bank, we collate a dataset including all the firms and banks that negotiated FX derivatives on a given day. Therefore, we assume that the FX derivatives marketplace comprises all the firms and banks that traded FX OTC derivatives on that day.[15]

In our model, we define a variable y_{ijt}, which takes the the value of 1 if firm i trades FX derivatives with bank j on day t. Conditional on firm i and bank j being in the marketplace on day t from quarter q, we estimate the following linear probability model:

$$y_{ijt} = \alpha + \beta_1 RelBank_{ijt} + \gamma X_{it} + \nu_{jt} + \delta_{iq} + \varepsilon_{ijt} \tag{1}$$

where $RelBank_{ijt}$ is one of our main measures of the lending relationship. We start by evaluating the impact of the existence of a lending relationship on the matching probability. Therefore, $RelBank_{ijt}$ is equal to 1 if firm i had any loan outstanding with bank j in the 12-month period before date t. X_{it} is a vector of firm characteristics (firm age, firm size, number of existing lending relationships, and dummies of export and import activities, which may be time-varying). ν_{jt} and δ_{iq} are bank-day and firm-quarter fixed effects, respectively. We further estimate the regressions with different saturation levels of fixed effects, as this approach allows us to gauge how much of the variation in the matching probabilities is determined by bank- and firm-specific features. Finally, ε_{ijt} is the error term. Heteroskedasticity-robust standard errors are clustered at the bank level.

[15] Our approach is similar to that of Bräuning and Fecht (2017), who investigate whether repeated interactions among market players result in high matching probabilities in the short-term interbank money market.

Table 4: Effect of the existence of a lending relationship on the matching probability in the FX OTC derivatives market

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	0.157***	0.109***	0.106***	0.105***	0.102***	0.103***	0.036***	0.036***
	(0.021)	(0.015)	(0.016)	(0.016)	(0.015)	(0.016)	(0.009)	(0.009)
Derivatives relationship (dummy)							0.227***	0.230***
							(0.018)	(0.018)
Controls	No	Yes	No	No	No	No	No	No
Firm FE	No	No	Yes	Yes	Yes	No	Yes	No
Bank FE	No	Yes	Yes	No	No	No	No	No
Day FE	No	Yes	Yes	No	No	No	No	No
Firm-Quarter FE	No	No	No	No	No	Yes	No	Yes
Bank-Day FE	No	No	No	Yes	Yes	Yes	Yes	Yes
Sample	All firms	All firms	All firms	All firms	Freq firms	Freq firms	Freq firms	Freq firms
Observations	3,174,849	2,861,672	3,174,849	3,174,849	3,050,167	3,050,167	3,050,167	3,050,167
Adjusted R^2	0.078	0.121	0.123	0.140	0.139	0.140	0.239	0.242

Notes: This table shows the results of the estimation of equation 1, using data from January 2010 to December 2014. We build a panel that includes all firms and banks that trade FX OTC derivatives on each day of the sample. In columns (5)–(8), we restrict the sample to the frequent firms, *i.e.* those firms that trade FX OTC derivatives in at least two quarters of the sample period. The dependent variable is a binary variable that assumes value 1 if firm i and bank j agree on a FX OTC derivatives contract on day t. Lending relationship is a binary variable equal to 1 if firm i has any outstanding loan balance with bank j in the previous 12 months, and 0 otherwise. Derivatives relationship is a binary variable equal to 1 if firm i has bought any FX OTC derivatives from bank j in the preceding 12 months, and 0 otherwise. We use the log of the firm age (months), log of the number of employees, number of lending relationships in the previous 12 months, and indicator variables of import and export activities as control variables in column(2). Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 4 reports the estimates of equation 1. The results show the relevance of the lending relationship for firms' access to the FX OTC derivatives market. Overall, when a firm buys an FX OTC derivative on a given day, lending relationship banks are 15.7 more percentage points more likely to supply one than other banks, as shown by the estimate in column (1). Since this regression does not contain any controls or fixed effects, one concern is that firms' or banks' omitted characteristics might bias our estimate. To address these concerns, in column (2), we add bank and day fixed effects as well as firm-level controls.[16] Although the magnitude of the main coefficient drops by 30% after adding these controls and fixed effects, it is still economically and statistically significant. Lending relationship banks are 10.9 percentage points more likely to be chosen as an FX derivatives provider than other banks. This estimate is robust to alternative specifications, with different saturation levels of fixed effects.

In column (3), we employ firm fixed effects instead of firm characteristics to encompass all firm-invariant features that might be correlated with the firm's preference for a specific supplier. We also use bank fixed effects to control for a bank's unobserved heterogeneity and day fixed effects to account for any shock that affects the FX market on a given day (*e.g.*, changes in the exchange rate and its volatility). The magnitude of our coefficient of interest is virtually unchanged compared to column (2).

In the estimation reported in column (4), we further saturate our specification and replace bank and day fixed effects with bank-day fixed effects to account for any macroeconomic shock that might heterogeneously affect banks' supply of FX OTC derivatives on a given day. For instance, one concern is that more aggressive players in the OTC derivatives market (*i.e.*, banks that charge lower spreads in their derivatives products) are also more leveraged and, therefore, more sensitive to macroeconomic shocks that affect FX volatility. We find that the lending relationship coefficient remains practically unchanged, while the R^2 is higher in this estimation than in the previous ones. In columns (5)–(8), we restrict our sample to firms that trade FX OTC derivatives in at least two quarters of the sample period to test whether our estimates are driven by firms that access the FX derivatives market only occasionally. Despite the large number of such firms, low

[16] In this specification, we lose approximately 10 percent of the observations due to missing values in the control variables.

frequency firms account for a small proportion of the overall number of contracts and notional value traded. Column (5) shows that our main coefficient remains practically unchanged for this restricted sample, mitigating the concerns that our previous results could be driven merely by firms' search costs. In column (6), our baseline specification, we apply firm-quarter fixed effects instead of firm fixed effects. This allows us to control for firms' time-varying demand for derivatives and creditworthiness, while bank-day fixed effects account for each bank's derivatives supply on each day, as mentioned earlier. The coefficient of interest is practically unchanged relative to the less saturated specifications.

One possible concern is reverse causation. Instead of a lending relationship causing a derivatives relationship, the firm might be more likely to enter into a lending relationship with its derivatives supplier than with other banks. In this case, our estimates would be driven by the correlation between this derivatives relationship and the lending relationship. In the estimations reported in columns (7) and (8), we add a dummy *Derivatives relationship* that takes 1 if firm i and bank j traded any FX derivative in the 12 months before day t. The results confirm that lending relationship is significant even after controlling for the previous derivatives relationship. The change in the magnitude of the coefficient of interest in these specifications relative to the previous ones likely reflects the correlation between the lending relationship and derivatives relationship in previous periods. We posit that the causation runs from lending to derivatives because firms' derivatives volume tends to be smaller than that of their loans, as showed in our descriptive analysis (see Section 2.2). Therefore, we proceed in our analysis by considering the regressions in columns (4) and (6) as our preferred specifications for the full sample of firms and sample of high frequency firms, respectively.

Table 5: Effect of lending relationship intensity on the matching probability in the FX OTC derivatives market

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	0.105***	0.090***			0.103***	0.089***		
	(0.016)	(0.013)			(0.016)	(0.013)		
Main bank (dummy)		0.092***				0.085***		
		(0.023)				(0.023)		
Concentration of lending			0.280***				0.265***	
			(0.050)				(0.051)	
Log (Relationship length)				0.019***				0.019***
				(0.003)				(0.003)
Firm FE	Yes	Yes	Yes	Yes	No	No	No	No
Firm-Quarter FE	No	No	No	No	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All firms	All firms	All firms	All firms	Freq firms	Freq firms	Freq firms	Freq firms
Observations	3,174,849	3,174,849	3,174,849	3,168,111	3,050,167	3,050,167	3,050,167	3,043,533
Adjusted R^2	0.140	0.144	0.141	0.138	0.140	0.144	0.140	0.139

Notes: This table shows the results of the estimation of equation 1, using data from January/2010 to December/2014. We build a panel that includes all firms and banks that trade FX OTC derivatives on each day of the sample. In columns (5)–(8), we restrict the sample to the frequent firms, *i.e.* those firms that trade FX OTC derivatives in at least two quarters of the sample period. The dependent variable is a binary variable that assumes value 1 if firm i and bank j agree on a FX OTC derivatives contract at day t. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

After documenting the impact of the existence of a lending relationship on the firm's choice of derivatives supplier, we investigate whether this effect differs according to the lending relationship intensity. Following the lending relationship literature,[17] we use three measures of lending relationship intensity: i) a dummy (*Main bank*) indicating whether bank j had the largest average loan amount outstanding to firm i among all the banks in the previous 12 months; ii) *Concentration of lending* defined as the proportion of loans granted by bank j to firm i in relation to the overall bank borrowing of firm i in the previous 12 months; and iii) *Log(Relationship length)*, defined as the natural logarithm of the relationship length between firm i and bank j in months.

Table 5 presents the results for both the full sample of firms (columns (1)–(4)) and the sample of high frequency firms (columns (5)–(8)). The specifications in columns (1) and (5) are identical to those in columns (4) and (6) of the previous table, respectively, to facilitate our comparison.

Overall, the estimations in Table 5 show that lending relationship intensity significantly impacts the matching probability. Column (2) shows that a firm is twice as likely to buy a derivative from its main bank than from any other lender. Moreover, the likelihood of trading with the main bank is approximately 18 percentage points higher than choosing a non-lending bank. The results in column (3) imply that a 10 percentage point increase in the concentration of loans with a bank yields a 2.8 percentage point higher likelihood of choosing that bank as a derivatives supplier. Relationship length is also significant. For a 10% increase in relationship length, the probability of choosing the bank rises by 2 percentage points. The analogous coefficients for the sample of high frequency firms (columns (6)–(8)) are similar to those in specifications (2)–(4), respectively.

Next, we examine a possible mechanism that could explain the impact of the lending relationship on the firm's choice of derivatives supplier. Relationship lending is a lending technology that permits the bank to acquire private information about the firm through repeated interactions and use it to set the terms of a loan contract. Private information is more relevant for smaller (more opaque) firms and its main benefits have been associated with greater access to credit (Petersen

[17] See Degryse, Kim, and Ongena (2009) for an extensive review on the subject.

and Rajan, 1994) and better contractual terms, such as higher loan amounts and lower collateral requirements (Berger and Udell, 1995; Bharath et al., 2011). Accordingly, we investigate whether the impact of lending relationship on the matching probability is higher for small firms. The private information the bank acquires from its lending relationship allows a better assessment of a firm's credit risk in the derivatives transaction. In the absence of that private information, a non-lending bank would have to charge a higher price for the derivatives contract to cover the cost of acquiring information about the firm or because the firm is assigned a higher risk category given information asymmetry. Moreover, based on previous empirical evidence that the lending relationship reduces collateral requirements (Degryse, Karapetyan, and Karmakar, 2021), it is reasonable to expect that relaxing collateral constraints improves access to the derivatives market. According to Rampini and Viswanathan's (2010; 2013) model, firms' decisions on financing and risk management are linked. Firms may refrain from using collateral for hedging purposes to conserve debt capacity and take advantage of future investment opportunities.[18] Therefore, we expect that small firms rely more on relationship banks when buying FX derivatives.

To estimate how firm size modulates the effect of the lending relationship on the matching probability, we estimate the following linear probability model:

$$y_{ijt} = \alpha + \beta_1 RelBank_{ijt} + \beta_2 RelBank_{ijt}.Small_i + \gamma X_{it} + \nu_{jt} + \delta_{iq} + \varepsilon_{ijt} \tag{2}$$

where in addition to the variables in equation 1, we add the interactions with $Small$, an indicator variable of whether the firm has no more than 250 employees in each quarter.

[18] Unfortunately, as we lack information on collateral at the contract level, we cannot test the prediction that lending relationship banks require less collateral than other banks. Nevertheless, based on aggregate data (Central Bank of Brazil, 2018, p. 113),collateral is required for only a small proportion of OTC derivatives contracts: Only 0.02% of NDF contracts are collateralized. Nevertheless, collateral requirements could serve as a selection device (i.e., relationship banks may be more likely to provide derivatives because previously acquired information may serve as a substitute for collateral).

Table 6: Differential effect of the lending relationship on the matching probability in the FX OTC derivatives market by firm size

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	0.087***	0.079***			0.087***	0.079***		
	(0.013)	(0.011)			(0.012)	(0.011)		
Lending relationship (dummy) x small	0.056***	0.034***			0.051***	0.034***		
	(0.014)	(0.011)			(0.013)	(0.011)		
Main bank (dummy)		0.063**				0.063**		
		(0.024)				(0.023)		
Main bank (dummy) x small		0.062***				0.048***		
		(0.020)				(0.016)		
Concentration of lending			0.218***				0.213***	
			(0.046)				(0.046)	
Concentration of lending x small			0.137***				0.118***	
			(0.041)				(0.034)	
Log (Relationship length)				0.016***				0.016***
				(0.003)				(0.003)
Log (Relationship length) x small				0.014***				0.013***
				(0.003)				(0.003)
Firm FE	Yes	Yes	Yes	Yes	No	No	No	No
Firm–Quarter FE	No	No	No	No	Yes	Yes	Yes	Yes
Bank–Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All firms	All firms	All firms	All firms	Freq firms	Freq firms	Freq firms	Freq firms
Observations	3,159,073	3,159,073	3,159,073	3,152,360	3,035,270	3,035,270	3,035,270	3,028,661
Adjusted R^2	0.142	0.146	0.143	0.142	0.142	0.145	0.142	0.142

Notes: This table shows the results of the estimation of equation 2, using data from January/2010 to December/2014. We built a panel data that includes all firms and banks that trade FX OTC derivatives in each day of the sample. We denote small firms as the firms with no more than 250 employees. In columns (5)–(8), we restrict the sample to the frequent firms, *i.e.* those firms that trade FX OTC derivatives in at least two quarters of the sample period. The dependent variable is a binary variable that assumes value 1 if firm i and bank j agree on a FX OTC derivatives contract at day t. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 6 reports the results of estimating equation 2 for both the sample of all firms (columns (1)–(4)) and the sample of high frequency firms (columns (5)–(8)). The lending relationship's impact on the matching probability is significantly stronger for small firms. The estimates in column (1) show that the effect of the existence of a lending relationship is approximately two-thirds higher for small firms than for large firms. As expected, the effect of relationship intensity on the matching probability is also stronger for small firms.[19] Hence, our estimates provide evidence that relationship lending facilitates access to the derivatives market for small firms.

In the estimations using the sample of high frequency firms reported in columns (5)–(8) of Table 6, the coefficients of the interaction variables are slightly lower than they are in their analogous regressions in the first four columns, but still statistically significant and economically relevant. These findings are consistent with our proposed mechanism. High frequency firms likely have more public (and, perhaps, private) information available due to their previous trading in the derivatives market. Therefore, they are less opaque than low frequency firms and benefit less from their lending relationships.

Finally, we perform a series of robustness checks to verify whether a previous derivatives relationship and its intensity are significant. We add controls for these measures and re-estimate the specifications reported in Tables 4–6. The results, presented in Tables A3–A6 in the Appendix A, show that our main inferences remain qualitatively unchanged.

3.2 FX Derivatives Price

In this subsection, we focus on the price of FX derivatives contracts and test whether firms are charged lower spreads in their derivatives contracts by lending relationship banks than other banks. We claim that lending relationship is a mechanism that lowers fixed transaction costs. After incurring the costs of assessing the firm's creditworthiness for the provision of loans, the bank is in a better position to provide derivatives to the same firm. Hence, firms trading derivatives with non-lending banks are expected to be larger and exhibit higher demand for FX derivatives,

[19] The additional impact for small firms in comparison to large firms can be computed based on the estimated coefficients as follows: i) existence of a lending relationship: $\frac{0.056}{0.087} = 0.64$; ii) main bank: $\frac{0.034+0.062}{0.079+0.063} = 0.68$; iii) concentration of lending: $\frac{0.137}{0.218} = 0.63$; and iv) relationship length: $\frac{0.014}{0.016} = 0.875$.

as their larger size of operations dilutes these additional fixed costs.

Ideally, we would like to observe all the quotes received from several banks to a given firm before closing a deal. However, we can only observe actual trades. Our econometric tests exploit the within-firm variation in derivatives pricing. In other words, we compare the prices that two or more banks charge the same firm in a certain period to test whether the derivatives price is lower when trading with relationship banks.

We restrict our analysis to plain vanilla contracts to avoid confounding effects and measurement error due to product differentiation. Specifically, we keep the simplest and most traded type of product, namely, BRL–USD NDF contracts between firms and banks with a maturity ranging from 20–360 days. As mentioned earlier, NDF contracts account for the vast majority of the contracts in our sample, and BRL–USD is the currency pair in 83% of the NDFs. Overall, 3124 firms take a long position in USD in these derivatives during our sample period.

As our identification strategy requires firms that trade derivatives with at least one lending relationship bank and one non-lending bank in the same quarter, Table A7 in the Appendix shows the main characteristics of the firms that fulfill this sample selection criterion. Most firms (73%) trade plain vanilla NDF contracts with only one type of bank throughout our sample period. These firms are smaller and younger, trade smaller amounts of FX derivatives in the previous 12 months period, and are less engaged in foreign trade than other firms. Among the sample of firms that trade derivatives with only one type of bank, 85% restrict their derivatives transactions to their lending relationship banks (Table A8), suggesting that the price charged by those banks is lower (or the set of contractual terms is more attractive) than the unobserved price charged by non-lending banks for these firms. Indeed, the smaller group of firms that trade only with non-lending banks have 72% more employees on average than firms that rely only on their lending relationship banks and their notional amount of FX OTC derivatives traded in the previous 12 months is five times that traded by other firms. These data suggest that trading derivatives with non-lending banks requires a larger-scale use of FX derivatives in a way that the economies of scale are sufficient to cover the fixed transaction or information costs incurred.

To assess whether derivatives prices are related to a previous lending relationship with the bank, we use the following specification:

$$Spread_{ijtk} = \alpha + \beta_1 RelBank_{ijt} + \gamma Z_{itk} + \nu_{jt} + \delta_{iq} + \varepsilon_{ijtk} \quad (3)$$

where our dependent variable is the percentage spread of contract k traded between firm i and bank j on day t from quarter q. The spread is the difference between the forward rate negotiated in the NDF contract and the future price of a standard contract for the same maturity as the NDF contract on the same day.[20] For future prices, we collect all daily settlement prices for different maturities informed by the B3 exchange. If no specific quotation matches the exact maturity of the NDF contract, we follow the procedure of Araujo and Leão (2016) and perform a cubic spline interpolation using the existing maturities of future contract prices. We winsorize the spread at the 1st and the 99th percentiles in the sample.

We use four measures of the lending relationship ($RelBank_{ijt}$), as defined in the previous section. Z_{itk} is a vector of contractual characteristics, namely the notional value and maturity of the contract. As the notional value increases, the fixed costs of contracting are diluted and the spread is expected to decrease. We further include a squared term to account for the fact that this decrease may be non-linear, either because there is a limit to the dilution of fixed costs or because extremely large contracts may imply additional costs to the providing banks.[21] Finally, we expect the spread to increase along with the maturity of the contract, as found by Alfaro, Calani, and Varela (2021). All else equal, the longer the maturity, the larger the bank's credit risk and hedging cost due to FX market liquidity. As discussed in the empirical analysis for matching probabilities (Section 3.1), ν_{jt} is a set of bank-day fixed effects that we employ to control for the bank's supply of FX derivatives. Hence, we consider any daily macroeconomic shock that affects each bank's supply of FX derivatives differently. Additionally, δ_{iq} is a set of firm-quarter fixed effects, which control for each firm's demand for FX derivatives and creditworthiness in every quarter. Therefore, our coefficient of interest measures, for the same firm in the same quarter,

[20] We compute the percentage NDF spread as $Spread = \frac{Forward - Future}{Future} \times 100$.

[21] We also run a model without the squared term (unreported), and our inferences are unchanged.

Table 7: Descriptive statistics of the sample of NDF contracts

	Obs	Median	Mean	Std.Dev.
NDF spread	23,986	0.06	0.09	0.41
Log(Notional)	23,989	14.16	14.20	1.78
Log(Maturity)	23,989	4.03	4.08	0.71
Lending relationship (dummy)	23,989	0.00	0.50	0.50
Main lending bank (dummy)	23,989	0.00	0.13	0.33
Concentration of lending	23,972	0.00	0.12	0.24
Log (Relationship length)	23,508	3.76	2.78	2.56

Notes: This table summarizes data at the contract level for plain vanilla NDFs (contracts with only one settlement date, maturities ranging from 20 to 360 days and no customization features) for firms that traded these NDFs with both at least one lending relationship bank and one non-lending bank in the same quarter from January/2010 to December/2014. NDF spread is the percentage difference between the forward exchange rate and corresponding future price for the same maturity of the contract. A lending relationship bank is a bank with which the firm had any outstanding loan balance in the previous 12 months and the main bank is the bank among the relationship banks with which the firm maintained the largest lending outstanding balance in the previous 12 months. The concentration of lending is the proportion of the total borrowing of a firm that is supplied by a bank in the preceding 12 months. Log(Relationship length) is the natural logarithm of the number of months of relationship between bank and firm. Log(Notional) corresponds to the natural logarithm of the notional value (in USD) of the contract and log(maturity) is the natural logarithm of the maturity of the contract.

how the spread varies across banks with different lending relationship statuses and intensities, controlling for bank supply and contract-specific features.

Table 7 presents the summary statistics for the selected sample of NDF contracts. The NDF spread displays a right-skewed distribution with a median equal to 6 basis points and mean equal to 9 basis points. This distribution presents substantial variation, as its standard deviation is 41 basis points. The sample is well balanced between NDFs traded with lending relationship and non-lending banks, as the mean of the Lending relationship dummy is 0.50. Moreover, 13% of contracts are traded between a firm and its main lending bank. The NDF supplier further provides around 12% of all the loans taken by the firm in the 12 preceding months on average and median length of the lending relationship between the firm and NDF provider is approximately 43 months.

Table 8 shows the results of estimating equation 3 for our lending relationship variables. As shown by our estimates, the lower spread charged by relationship banks depends primarily on the lending relationship intensity, but not on its mere existence (or its length). Column (1) shows that we find no significant differences in NDF spreads due to the existence of a lending relationship. However, when firms trade FX derivatives with their main lending bank, they are charged on average 3 basis points less than they are by other banks, as shown by the estimate in column (2). This impact is statistically significant at the 1% level and economically relevant, as it represents 30% of the average spread charged in the contracts in our sample. The coefficient of the concentration of lending measure (column (3)) is also consistent with the hypothesis that the lending relationship intensity is associated with a lower NDF spread. A one standard deviation increase in the concentration of lending yields a decrease of 0.7 basis points, or 6% of the average NDF spread. These results suggest that the size of the credit exposure that a bank has with a firm (*i.e.*, its lending intensity) may provide derivatives at more favorable terms (*i.e.*, a lower spread) as an incentive for the firm to reduce its risk, in the spirit of Bessembinder (1991). Finally, the lending relationship length is not significantly correlated with derivatives prices, as shown in column (4). All the specifications reported in Table 8 show that the spread increases with the maturity of the contract and decreases with the notional value at a decreasing rate (as the coefficient of the squared term is positive).

After having documented the negative impact of the intensity of the lending relationship on derivatives prices, we investigate whether this effect is more pronounced among smaller (more opaque) firms, which would be consistent with the information asymmetry channel as the driver of our results. We follow the same approach as in Section 3.1 and add the interaction of the relationship variable with the small firm dummy into our previous equation as follows:

$$Spread_{ijtk} = \alpha + \beta_1 RelBank_{ijt} + \beta_2 RelBank_{ijt}.Small_i + \gamma Z_{itk} + \nu_{jt} + \delta_{iq} + \varepsilon_{ijtk} \tag{4}$$

Table 8: Effect of the lending relationship on the FX derivatives price

	(1)	(2)	(3)	(4)
Lending relationship (dummy)	-0.002	0.006		
	(0.006)	(0.007)		
Main bank (dummy)		-0.031***		
		(0.008)		
Concentration of lending			-0.030***	
			(0.007)	
Log (Relationship length)				0.000
				(0.001)
Log(Notional)	-0.126***	-0.128***	-0.128***	-0.137***
	(0.030)	(0.030)	(0.030)	(0.028)
$Log(Notional)^2$	0.004***	0.004***	0.004***	0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
Log(Maturity)	0.059***	0.059***	0.059***	0.061***
	(0.011)	(0.011)	(0.011)	(0.011)
Firm-Quarter FE	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes
Observations	23,986	23,986	23,969	23,505
Adjusted R^2	0.808	0.808	0.808	0.812

Notes: This table shows the results of the estimation of equation 3, using data from the sample of firms that traded plain vanilla NDFs (contracts with only one settlement date, maturities ranging from 20–360 days, and no customized features) with both a lending relationship and non-lending bank in the same quarter from January 2010 to December 2014. The dependent variable is the NDF spread, which is measured as the percentage difference between the forward exchange rate and corresponding future price for the same contract maturity. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Log(Notional) corresponds to the natural logarithm of the notional value (in USD) of the contract and log(Maturity) is the natural logarithm of the maturity of the contract. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 9 displays the estimates for equation 4 for our four measures of the lending relationship. Our previous inferences about the absence of an effect of the existence of a lending relationship and of relationship length continue to hold when we consider differences in size, as the coefficients β_1 and β_2 in columns (1) and (4) are not statistically significant at conventional levels. More importantly, the results in column (2) are consistent with the information asymmetry mechanism. Although the impact of the existence of a lending relationship on the NDF spread is not significant for large firms, the differential impact for small firms is measured as a large (3.4 basis points) increase in the prices of FX derivatives. This result suggests that small firms pay a premium to access the derivatives market with their non-preferential lender. Additionally, the coefficient of the *main bank* dummy indicates that large firms are charged a significantly lower spread (2.1 basis points) by their main lending bank than by other banks. The interaction term between the main lending bank and small firm indicator variables shows that the lower spreads charged by the main lending bank are even more relevant for small firms. The spread charged by the main lending bank from small firms is 6.7 basis points lower than the amount charged by other lending relationship banks on average. Overall, the spread reduction obtained by small firms from their main bank is approximately 3.5 basis points, statistically significant at the 5% level,[22] which represents a reduction of almost 40% compared with the average sample spread. Column (3) shows the negative and statistically significant effect of the concentration of lending on the NDF spread for large firms. The coefficient of the interaction term suggests that this effect is even stronger for small firms, though the estimate is not statistically significant at the usual levels.

We examine the robustness of the results to controlling for the bank relationship in the derivatives market to consider the alternative explanation that previous interactions in the derivatives market are more relevant than the lending relationship when banks price their derivatives. The results in Tables A9 and A10 in the Appendix show that our previous results remain practically unchanged.

We further explore the variation in the intensive margin in the lending relationship by comparing firms that trade derivatives with two or more lending relationship banks in the same

[22]The overall effect is calculated as the sum of the coefficient of the main effect terms of the regression (*i.e.*, the dummies of the lending relationship and main bank) and coefficients of the interaction terms.

Table 9: Differential effect of the lending relationship on the FX derivatives price by firm size

	(1)	(2)	(3)	(4)
Lending relationship (dummy)	-0.006	-0.002		
	(0.004)	(0.006)		
Lending relationship (dummy) x small firms	0.014	0.034***		
	(0.011)	(0.011)		
Main bank (dummy)		-0.021**		
		(0.009)		
Main bank (dummy) x small firms		-0.046***		
		(0.009)		
Concentration of lending			-0.025***	
			(0.009)	
Concentration of lending x small firms			-0.017	
			(0.018)	
Log (Relationship length)				-0.001
				(0.001)
Log (Relationship length) x small firms				0.004
				(0.003)
Controls	Yes	Yes	Yes	Yes
Firm-Quarter FE	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes
Observations	23,848	23,848	23,831	23,367
Adjusted R^2	0.809	0.809	0.809	0.813

Notes: This table shows the results of the estimation of equation 4, using data from the sample of firms that traded plain vanilla NDFs (contracts with only one settlement date, maturities ranging from 20–360 days, and no customized features) with both a lending relationship and non-lending bank in the same quarter from January 2010 to December 2014. The dependent variable is the NDF spread, which is measured as the percentage difference between the forward exchange rate and corresponding future price for the same contract maturity. We denote small firms as the firms with no more than 250 employees. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Log(Notional) corresponds to the natural logarithm of the notional value (in USD) of the contract and log(Maturity) is the natural logarithm of the maturity of the contract. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

quarter. Table A11 in the Appendix shows that more firms trade derivatives with two relationship banks than the number of firms that trade with both types (lending relationship and non-lending banks) in the same quarter. Moreover, firms that trade derivatives with two relationship banks are smaller, younger, and less likely to export than firms that trade derivatives with both types of banks. Thereafter, we run a regression of the derivatives price on the lending relationship intensity, controlling for the same variables as in equations 3 and 4. The results in Table A12 in the Appendix support the hypothesis that the additional information provided by more intense lending relationships is more relevant for small firms. The NDF spread reduction obtained by small firms from their main lending bank is 56% lower than the average sample spread (column (3)). We observe similar results for the concentration of lending measure (column(4)).

3.3 Other Contractual Terms

In this section, we examine whether the lending relationship affects the terms of other FX OTC derivatives by focusing on the notional value, maturity, and customization of derivatives. We define an OTC contract as customized if it does not have a similar exchange-traded product. Therefore, FX OTC derivatives that include specific clauses, such as barriers and options, are considered to be customized derivatives. We further classify contracts with a maturity longer than 360 days, contracts that trade currencies other than USD, and cross-currency swaps using interest rates other than Brazil's reference floating interest rate as customized.

In contrast to the price analysis in which we use data at the contract level, we aggregate the data at the firm-bank-quarter level in this set of tests. Therefore, if a firm has more than one contract with the same bank in the same quarter, we add the notional value of these contracts, take the notional-weighted average maturity among these contracts, and compute the share of customized derivatives as the sum of the notional amount of customized contracts over the notional amount of all the FX contracts traded with the bank by the firm in a quarter.

Table 10: Summary statistics – FX OTC Derivatives at the firm-bank-quarter level

	Entire Sample				Small Firms				Other Firms			
	Obs	Median	Mean	Std.Dev.	Obs	Median	Mean	Std.Dev.	Obs	Median	Mean	Std.Dev.
Notional (USD million)	10,006	6.59	25.35	70.83	2,747	2.57	8.32	19.54	7,247	9.77	31.85	81.42
Maturity (days)	10,006	81.29	141.24	237.53	2,747	59.79	98.55	116.61	7,247	90.14	157.53	267.93
Share of customized FX OTC contracts	10,006	0.00	0.14	0.32	2,747	0.00	0.10	0.29	7,247	0.00	0.15	0.34
Share of NDF contracts	10,006	1.00	0.81	0.38	2,747	1.00	0.87	0.32	7,247	1.00	0.79	0.40
Log(Notional)	10,006	15.70	15.65	1.76	2,747	14.76	14.76	1.56	7,247	16.09	15.98	1.71
Log(Maturity)	10,006	4.40	4.42	0.97	2,747	4.09	4.15	0.92	7,247	4.50	4.52	0.98

Notes: This table summarizes data at the firm-bank-quarter level along the period from January 2010 to December 2014. Small firms are firms with no more than 250 employees. The share of customized derivatives is defined as the number of customized derivatives over the total number of derivatives traded between a firm and a bank in a given quarter. The other variables are defined as in the previous tables.

Table 10 displays the summary statistics of the main outcome variables we employ in this section. Our outcome measures vary substantially by firm size. While the overall average notional value traded with a given bank is USD 25 million per firm per quarter, the value traded by large firms (USD 32 million) is about four times the average value negotiated by small firms (USD 8 million). Additionally, the average maturity of the contracts traded by large firms is 60% longer than that agreed by small firms in the sample. Finally, the average share of customized FX OTC derivatives traded by large firms is 50% higher than that for small firms.

As we have already established the relevance of the lending relationship for the choice of derivatives supplier (Section 3.1) and for the distribution of FX derivatives' demand between bank types (lending relationship and non-lending banks),[23] our empirical methodology presented in this subsection aims to recover the marginal preference for relationship banks, given that the firm's demand for FX OTC derivatives is fulfilled by more than one type of bank in a given quarter. Therefore, we test whether, among this set of firms, the proportion of the notional amount of derivatives provided by a bank varies according to the existence of a lending relationship and its intensity. Additionally, we test whether the two types of banks are associated with different features for the derivatives contracts traded. Namely, we investigate whether the maturity of the contracts and level of customization differ when FX derivatives are supplied by lending relationship banks rather than non-lending banks.

Table A13 in the Appendix compares the sample of firms that trade with both types of banks in a given quarter (included in the regressions) with the remaining firms (excluded from the regressions). Firms that trade with more than one type of bank in a given quarter are larger, older, and more likely to engage in foreign trade than the remaining firms. They also trade a significant larger notional amount, and their contracts exhibit shorter maturity compared with other firms.

We estimate the following regression models to gauge the effect of the lending relationship on each of our outcomes of interest and test for the existence of different effects depending on firm

[23]Recall the results presented in Section 2.2: 50% of the firms that trade FX OTC derivatives from 2010–2014 rely only on lending relationship banks, and the average firm in our sample trade 80% of their demand for FX OTC derivatives with lending relationship banks.

size:

$$Outcome_{ijt} = \alpha + \beta_1 RelBank_{ijt} + \nu_{jt} + \delta_{it} + \varepsilon_{ijt} \tag{5}$$

$$Outcome_{ijt} = \alpha + \beta_1 RelBank_{ijt} + \beta_2 RelBank_{ijt}.Small_i + \nu_{jt} + \delta_{it} + \varepsilon_{ijt} \tag{6}$$

where $Outcome_{ijt}$ can take one of the following measures for the contracts negotiated between firm i and bank j in quarter t: i) the log of the total notional value traded; ii) log of the notional-weighted maturity; and iii) share of customized FX OTC derivatives contracts. As discussed earlier, firm-quarter fixed effects (δ_{it}) control for a firm's time-varying demand for FX derivatives and creditworthiness. ν_{jt} represents bank-quarter fixed effects, which we employ to control for the differences in banks' characteristics related to their supply of FX derivatives in a given quarter. Therefore, our coefficients of interest measure, for the same firm in each quarter, how the outcome varies depending on the existence and intensity of the firm's lending relationship with a given bank in that quarter.

Table 11 shows the estimates for the log of the notional amount as the dependent variable. The odd columns report the main effects of the lending relationship variables on the outcome variable, while the even columns display the estimations that include the interaction with the *small firm* variable. Although the effect of the existence of a lending relationship is statistically significant at the 10% level in some of the specifications (columns (2) and (3)), this result is not robust across the other specifications, as reported in columns (1) and (4). Additionally, the differential impact of *main bank* on small firms, which we obtain by adding all the main effects and interaction terms, is not statistically significant at the usual levels.

One possible explanation for our results relies on the assumption of large fixed costs to screening non-borrowing clients. In this case, we should observe trades between firms and non-lending banks only when the notional amounts are sufficiently large, such that the competitive spread charged is high enough to cover these fixed costs. Thus, in quarters in which a firm trades FX derivatives with both types of banks, its trades with non-lending banks would involve high notional values (or at least the same magnitude as those trades with relationship banks).

Table 11: Effect of the lending relationship on the notional amount

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	0.043	0.079*	0.053*	0.077				
	(0.031)	(0.045)	(0.027)	(0.046)				
Lending relationship (dummy) x small firms		-0.102		-0.069				
		(0.088)		(0.079)				
Main bank (dummy)			-0.033	0.005				
			(0.040)	(0.025)				
Main bank (dummy) x small firms				-0.081				
				(0.071)				
Concentration of lending					0.012	0.067		
					(0.080)	(0.080)		
Concentration of lending x small firms						-0.118		
						(0.121)		
Log (Relationship length)							0.004	0.007
							(0.008)	(0.009)
Log (Relationship length) x small firms								-0.011
								(0.019)
Firm-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,006	9,918	10,006	9,918	9,921	9,833	9,944	9,856
Adjusted R^2	0.796	0.797	0.796	0.797	0.797	0.798	0.797	0.798

Notes: This table shows the results of the estimation of equations 5 and 6, using data from the sample of firms that traded plain FX OTC derivatives with both a lending relationship and non-lending bank in the same quarter from January 2010 to December 2014. The dependent variable is the natural logarithm of the quarter aggregated notional amount (in USD). We denote small firms as the firms with no more than 250 employees. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 12: Effect of the lending relationship on the maturities of derivatives

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	-0.018	-0.008	-0.016	-0.004				
	(0.013)	(0.014)	(0.016)	(0.019)				
Lending relationship (dummy) x small firms		-0.025		-0.035				
		(0.026)		(0.031)				
Main bank (dummy)			-0.007	-0.015				
			(0.019)	(0.029)				
Main bank (dummy) x small firms				0.031				
				(0.042)				
Concentration of lending					-0.002	0.002		
					(0.014)	(0.023)		
Concentration of lending x small firms						-0.012		
						(0.042)		
Log (Relationship length)							0.000	0.002
							(0.004)	(0.004)
Log (Relationship length) x small firms								-0.004
								(0.005)
Firm-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,006	9,918	10,006	9,918	9,921	9,833	9,944	9,856
Adjusted R^2	0.810	0.810	0.810	0.810	0.808	0.808	0.809	0.809

Notes: This table shows the results of the estimation of equations 5 and 6, using data from the sample of firms that traded plain FX OTC derivatives with both a lending relationship and non-lending bank in the same quarter from January 2010 to December 2014. The dependent variable is the natural logarithm of the derivatives maturity (in days). We denote small firms as the firms with no more than 250 employees. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table 13: Effect of the lending relationship on the share of customized FX OTC contracts

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	-0.009	-0.007	-0.010	-0.010				
	(0.007)	(0.009)	(0.007)	(0.008)				
Lending relationship (dummy) x small firms		-0.005		0.001				
		(0.008)		(0.008)				
Main bank (dummy)			0.004	0.012				
			(0.008)	(0.011)				
Main bank (dummy) x small firms				-0.019				
				(0.012)				
Concentration of lending					-0.005	0.001		
					(0.013)	(0.017)		
Concentration of lending x small firms						-0.012		
						(0.014)		
Log (Relationship length)							-0.001	-0.000
							(0.002)	(0.002)
Log (Relationship length) x small firms								-0.003*
								(0.001)
Firm-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,006	9,918	10,006	9,918	9,921	9,833	9,944	9,856
Adjusted R^2	0.774	0.774	0.774	0.774	0.774	0.773	0.774	0.773

Notes: This table shows the results of the estimation of equations 5 and 6, using data from the sample of firms that traded plain FX OTC derivatives with both a lending relationship and non-lending bank in the same quarter from January 2010 to December 2014. The dependent variable is the share of customized FX OTC Contracts, defined as the sum of the notional amount of FX customized contracts over the total amount of notional of all FX contracts the firm traded with the bank in a quarter. We denote small firms as the firms with no more than 250 employees. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Next, Table 12 reports the estimates of the log of the maturity as our dependent variable in equations 5 and 6. We find no evidence of a significant effect of our lending relationship measures by themselves (odd columns), nor for the interaction terms (even columns).

Table 13 shows the estimates of equations 5 and 6 using the share of customized derivatives contracts as our dependent variable. Although the estimated coefficients of the main effects of our lending relationship measures are not statistically significant at conventional levels, the overall differential effect of the main lending bank for small firms is -1.7 percentage points (statistically significant at 5%, according to an F-test for the sum of coefficients), which represents 12% of the average customization level of the OTC derivatives contracts in our sample (column (4)). One possible explanation of this result is that the main bank's advantage through its acquisition of private information from its lending relationship with the firm is less relevant when dealing with more complex products. Since those customized products tend to be costlier to set up than plain vanilla contracts and may require the acquisition of contract-specific information, non-lending banks may become more competitive in this situation.

To mitigate concerns about sample selection and further understand the effect of lending relationship for a different group of firms, we explore the variation in the intensive margin in the lending relationship by comparing the notional amount, contract maturity, and customization share for firms that trade derivatives with two or more lending relationship banks in the same quarter. Table A14 presents the results of these estimations. We find that firms trade a larger notional amount (5.2% more) with their main bank than with other lending relationship banks (column (1)). Nevertheless, we cannot reject the null hypothesis at standard levels that there is no difference between the main bank and other lending relationship banks for small firms (column (2)). Columns (3)-(6) show no statistically significant difference for the contract maturity and share of customized features when comparing the main bank with other lending relationship banks

Finally, we re-estimate the regressions reported in this subsection controlling for the previous existence of a derivatives relationship between banks and firms. Our results (unreported) are unaffected by the inclusion of these controls

4 Conclusion

This study examines the role of financial intermediaries in providing OTC derivatives to non-financial firms. We find that firms are more likely to trade FX OTC derivatives with a bank with which they have a lending relationship than with other banks. The intensity of the relationship is also significant, as we find that the higher the proportion of the firm's borrowing from a given bank, the higher is the likelihood of trading a derivative with that bank. Both these results are stronger among small firms. We also show that the intensity of the bank relationship reduces the price of OTC derivatives and that this effect is also stronger among small firms. However, the mere existence of a lending relationship does not seem to affect the price of derivatives.

Moreover, we find no evidence of difference in terms of notional amount and maturity of the derivatives contracts provided by lending relationship banks and non-lending banks, when we analyze firms trading FX OTC derivatives with the two types of banks in the same quarter. We obtain weak evidence showing that a larger share of customization features (contracts with maturity longer than 360 days, underlying currencies different from USD, swaps and NDF with barriers and other option based features, among others) are more likely to be provided by non-lending banks.

These results shed light on the relevance of informational costs to the provision of FX OTC derivatives, particularly for small (opaque) firms. In addition, offering hedging to borrowers at favorable terms is consistent with banks aiming to reduce their loan portfolio risk, as proposed by Bessembinder (1991). In particular, our inferences highlight the relevance of the universal bank model (as discussed, for instance, by Neuhann and Saidi (2018) and Puri and Rocholl (2008)) that allows the same financial intermediary to combine both commercial and investment banking businesses.

Our results have implications for policies and regulations on information-sharing mechanisms. Initiatives that reduce firm opaqueness such as *open banking* may improve the access of firms to markets other than the loan market. For example, information-sharing mechanisms could improve the information set of a non-lending bank about a potential customer, which would eventually allow this non-lending bank to provide OTC derivatives at a lower cost than otherwise.

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A Appendix

Table A1: Comparing small and large firms – sample of low frequency firms

	Small Firms				Other Firms				Diff
	Obs	Median	Mean	Std.Dev.	Obs	Median	Mean	Std.Dev.	
Number of employees	2196	42.00	68.26	66.83	741	549.00	1343.07	3399.84	1274.81***
Firm's age (months)	2121	180.00	208.73	138.93	693	282.00	309.52	171.00	100.79***
Importer (dummy)	2196	1.00	0.53	0.50	741	1.00	0.60	0.49	0.07**
Exporter (dummy)	2196	0.00	0.24	0.42	741	0.00	0.44	0.49	0.20***
Derivatives ratio	2156	0.00	0.01	0.07	723	0.00	0.01	0.08	0.01
NDF-to-total derivatives ratio	2196	1.00	0.66	0.44	741	0.50	0.50	0.46	-0.17***
Derivatives share with relationship banks	2196	1.00	0.86	0.34	741	1.00	0.84	0.34	-0.02
Derivatives share with the main bank	2196	0.22	0.48	0.48	741	0.00	0.31	0.44	-0.16***
Maturity (days)	2196	201.91	308.76	297.24	741	311.36	436.76	444.02	128.00***
Notional (USD million)	2196	0.30	1.17	7.32	741	0.87	5.28	16.51	4.11***

Notes: This table summarizes data at the firm level along the period from January/2010 to December/2014. Small firms are those with no more than 250 employees. Low frequency firms are those that trade derivatives in only one quarter of the sample. We compute the number of employees and firm age (measured in months) as the median value along the sample period. The derivatives ratio is the proportion of FX derivatives outstanding with respect to the sum of FX derivatives' notional value and loan amount outstanding. The NDF-to-total derivatives ratio is the ratio of the notional value of FX NDF contracts to the total FX OTC notional amount traded between the firm and all the banks in the sample period. The derivatives share with relationship banks and derivatives share with the main bank are respectively the share of the FX OTC notional amount traded with all relationship banks and with the main bank in the sample period. A lending relationship bank is a bank with which the firm had any outstanding loan balance in the previous 12 months and the main bank is the bank among the relationship banks with which the firm maintained the largest lending outstanding balance in the previous 12 months. The last column shows the mean difference between small firms and large firms for each variable.

Table A2: Comparing small and large firms – sample of high frequency firms

	Small Firms				Other Firms				Diff
	Obs	Median	Mean	Std.Dev.	Obs	Median	Mean	Std.Dev.	
Number of employees	1873	60.50	81.01	69.61	1357	823.00	2155.86	4992.47	2074.85***
Firm's age (months)	1842	183.00	216.45	145.22	1333	327.50	329.76	173.43	113.31***
Importer (dummy)	1873	1.00	0.78	0.41	1357	1.00	0.80	0.39	0.03
Exporter (dummy)	1873	0.00	0.39	0.48	1357	1.00	0.64	0.48	0.25***
Derivatives ratio	1872	0.01	0.10	0.23	1357	0.02	0.12	0.24	0.02*
NDF-to-total derivatives ratio	1873	1.00	0.76	0.36	1357	0.73	0.59	0.41	-0.17***
Derivatives share with relationship banks	1873	1.00	0.78	0.33	1357	0.83	0.71	0.32	-0.07***
Derivatives share with the main bank	1873	0.19	0.34	0.37	1357	0.07	0.20	0.28	-0.14***
Maturity (days)	1873	129.50	175.56	197.40	1357	149.61	255.90	312.24	80.33***
Notional (USD million)	1873	0.41	1.80	6.05	1357	1.67	7.48	24.16	5.69***

Notes: This table summarizes data at the firm level along the period from January/2010 to December/2014. Small firms are those with no more than 250 employees. High frequency firms are those that trade derivatives in more than one quarter of the sample. We compute the number of employees and firm age (measured in months) as the median value along the sample period. The derivatives ratio is the proportion of FX derivatives outstanding with respect to the sum of FX derivatives' notional value and loan amount outstanding. The NDF-to-total derivatives ratio is the ratio of the notional value of FX NDF contracts to the total FX OTC notional amount traded between the firm and all the banks in the sample period. The derivatives share with relationship banks and derivatives share with the main bank are respectively the share of the FX OTC notional amount traded with all relationship banks and with the main bank in the sample period. A lending relationship bank is a bank with which the firm had any outstanding loan balance in the previous 12 months and the main bank is the bank among the relationship banks with which the firm maintained the largest lending outstanding balance in the previous 12 months. The last column shows the mean difference between small firms and large firms for each variable.

Table A3: Effect of the intensity of the lending relationship on the matching probability in the FX OTC derivatives market – Robustness check: controlling for previous derivatives relationship

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	0.042***	0.029***			0.036***	0.025***		
	(0.009)	(0.007)			(0.009)	(0.007)		
Main bank (dummy)		0.077***				0.068***		
		(0.020)				(0.020)		
Concentration of lending			0.181***				0.159***	
			(0.040)				(0.040)	
Log (Relationship length)				0.006***				0.005***
				(0.002)				(0.002)
Derivatives relationship (dummy)	0.223***	0.222***	0.223***	0.228***	0.230***	0.228***	0.229***	0.234***
	(0.019)	(0.018)	(0.019)	(0.019)	(0.018)	(0.018)	(0.019)	(0.019)
Firm FE	Yes	Yes	Yes	Yes	No	No	No	No
Firm-Quarter FE	No	No	No	No	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All firms	All firms	All firms	All firms	Freq firms	Freq firms	Freq firms	Freq firms
Observations	3,174,849	3,174,849	3,174,849	3,168,111	3,050,167	3,050,167	3,050,167	3,043,533
Adjusted R^2	0.236	0.239	0.241	0.237	0.242	0.244	0.246	0.243

Notes: This table shows the results of the estimation of equation 1 controlling for previous relationship in the FX OTC derivatives market. Using data from January/2010 to December/2014, we build a panel data that includes all firms and banks that trade FX OTC derivatives on each day of the sample. Derivatives relationship is a binary variable equal to 1 if firm i has bought any FX OTC derivatives from bank j in the previous 12 months, and 0 otherwise. In columns (5)–(8), we restrict the sample to the frequent firms, *i.e.* those firms that trade FX OTC derivatives in at least two quarters of the sample period. The dependent variable is a binary variable that assumes value 1 if firm i and bank j agree on a FX OTC derivatives contract at day t. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table A4: Effect of the intensity of the lending relationship on the matching probability in the FX OTC derivatives market – Robustness check: controlling for previous derivative relationship and for the main derivatives supplier

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	0.032***	0.023***			0.026***	0.019***		
	(0.007)	(0.005)			(0.006)	(0.004)		
Main bank (dummy)		0.053***				0.043***		
		(0.014)				(0.014)		
Concentration of lending			0.129***				0.105***	
			(0.030)				(0.028)	
Log (Relationship length)				0.005***				0.004***
				(0.001)				(0.001)
Derivatives relationship (dummy)	0.160***	0.160***	0.162***	0.163***	0.167***	0.166***	0.168***	0.169***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.012)	(0.012)	(0.013)	(0.013)
Main Derivatives bank(dummy)	0.309***	0.305***	0.302***	0.313***	0.309***	0.306***	0.303***	0.313***
	(0.010)	(0.009)	(0.009)	(0.010)	(0.010)	(0.009)	(0.009)	(0.010)
Firm FE	Yes	Yes	Yes	Yes	No	No	No	No
Firm-Quarter FE	No	No	No	No	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All firms	All firms	All firms	All firms	Freq firms	Freq firms	Freq firms	Freq firms
Observations	3,174,849	3,174,849	3,174,849	3,168,111	3,050,167	3,050,167	3,050,167	3,043,533
Adjusted R^2	0.291	0.292	0.293	0.293	0.298	0.299	0.299	0.300

Notes: This table shows the results of the estimation of equation 1 controlling for previous relationship in the FX OTC derivatives market. Using data from 2010 to 2014, we build a panel data that includes all firms and banks that trade FX OTC derivatives in each day of the sample. Derivatives relationship is a binary variable equal to 1 if firm i has bought any FX OTC derivatives from bank j in the previous 12 months, and 0 otherwise. Main derivatives bank is a binary variable equal to 1 if bank j is the bank that provides the largest notional amount of FX OTC derivatives to firm i in the previous 12 months, and 0 otherwise. In columns (5)–(8), we restrict the sample to the frequent firms, *i.e.* those firms that trade FX OTC derivatives in at least two quarters of the sample period. The dependent variable is a binary variable that assumes value 1 if firm i and bank j agree on a FX OTC derivatives contract at day t. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table A5: Differential impact of the lending relationship on the matching probability in the FX OTC derivatives market by firm size – Robustness check: controlling for previous derivative relationship

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	0.028***	0.022***			0.027***	0.021***		
	(0.007)	(0.005)			(0.007)	(0.005)		
Lending relationship (dummy) x small	0.041***	0.024***			0.028***	0.016**		
	(0.014)	(0.009)			(0.009)	(0.007)		
Main bank (dummy)		0.049**				0.048**		
		(0.020)				(0.020)		
Main bank (dummy) x small		0.055**				0.037*		
		(0.023)				(0.019)		
Concentration of lending			0.117***				0.113***	
			(0.034)				(0.034)	
Concentration of lending x small			0.125**				0.088**	
			(0.050)				(0.039)	
Log (Relationship length)				0.004***				0.004***
				(0.001)				(0.001)
Log (Relationship length) x small				0.009***				0.006***
				(0.003)				(0.002)
Derivatives relationship (dummy)	0.207***	0.207***	0.208***	0.211***	0.211***	0.210***	0.212***	0.215***
	(0.015)	(0.015)	(0.015)	(0.016)	(0.015)	(0.015)	(0.015)	(0.016)
Derivatives relationship (dummy) x small	0.066***	0.064***	0.063***	0.064***	0.074***	0.072***	0.070***	0.072***
	(0.019)	(0.019)	(0.021)	(0.019)	(0.018)	(0.018)	(0.019)	(0.018)
Firm FE	Yes	Yes	Yes	Yes	No	No	No	No
Firm-Quarter FE	No	No	No	No	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All firms	All firms	All firms	All firms	Freq firms	Freq firms	Freq firms	Freq firms
Observations	3,159,073	3,159,073	3,159,073	3,152,360	3,035,270	3,035,270	3,035,270	3,028,661
Adjusted R^2	0.241	0.244	0.246	0.242	0.246	0.249	0.250	0.248

Notes: This table shows the results of the estimation of equation 2, when we control for previous relationship in the FX OTC derivatives market. Using data from January/2010 to December/2014, we built a panel data that includes all firms and banks that trade FX OTC derivatives in each day of the sample. Derivatives relationship is a binary variable equal to 1 if firm i has bought any FX OTC derivatives from bank j in the previous 12 months, and 0 otherwise. We denote small firms as the firms with no more than 250 employees. In columns (5)–(8), we restrict the sample to the frequent firms, *i.e.* those firms that trade FX OTC derivatives in at least two quarters of the sample period. The dependent variable is a binary variable that assumes value 1 if firm i and bank j agree on a FX OTC derivatives contract at day t. The other variables are defined as in the previous tables. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table A6: Differential effect of the lending relationship on the matching probability in the FX OTC derivatives market by firm size – Robustness check: controlling for previous derivatives relationship and for the main derivatives supplier

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	0.020***	0.016***			0.019***	0.015***		
	(0.005)	(0.004)			(0.005)	(0.004)		
Lending relationship (dummy) x small	0.037***	0.025***			0.022***	0.015***		
	(0.013)	(0.009)			(0.007)	(0.006)		
Main lending bank (dummy)		0.031**				0.030**		
		(0.015)				(0.015)		
Main lending bank (dummy) x small		0.040**				0.021*		
		(0.016)				(0.012)		
Concentration of lending			0.076***				0.072***	
			(0.025)				(0.025)	
Concentration of lending x small			0.105**				0.063**	
			(0.041)				(0.027)	
Log (Relationship length)				0.003***				0.003***
				(0.001)				(0.001)
Log (Relationship length) x small				0.008***				0.005***
				(0.003)				(0.002)
Derivatives relationship (dummy)	0.164***	0.164***	0.165***	0.167***	0.168***	0.168***	0.170***	0.171***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Derivatives relationship (dummy) x small	-0.013	-0.014	-0.010	-0.017	-0.006	-0.006	-0.004	-0.008
	(0.016)	(0.016)	(0.016)	(0.016)	(0.013)	(0.013)	(0.014)	(0.013)
Main derivatives bank(dummy)	0.256***	0.254***	0.253***	0.261***	0.255***	0.254***	0.253***	0.260***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
Main derivatives bank(dummy) x small	0.144***	0.139***	0.134***	0.141***	0.145***	0.143***	0.139***	0.142***
	(0.019)	(0.017)	(0.015)	(0.020)	(0.020)	(0.018)	(0.017)	(0.021)
Firm FE	Yes	Yes	Yes	Yes	No	No	No	No
Firm-Quarter FE	No	No	No	No	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All firms	All firms	All firms	All firms	Freq firms	Freq firms	Freq firms	Freq firms
Observations	3,159,073	3,159,073	3,159,073	3,152,360	3,035,270	3,035,270	3,035,270	3,028,661
Adjusted R^2	0.295	0.297	0.298	0.298	0.302	0.303	0.304	0.305

Notes: This table shows the results of the estimation of equation 2, when we control for previous relationship in the FX OTC derivatives market. Using data from January/2010 to December/2014, we built a panel data that includes all firms and banks that trade FX OTC derivatives in each day of the sample. Derivatives relationship is a binary variable equal to 1 if firm i has bought any FX OTC derivatives from bank j in the previous 12 months, and 0 otherwise. Main derivatives bank is a dummy variable indicating the bank with which the firm traded the largest amount of FX OTC derivatives in the previous 12 months. We denote small firms as the firms with no more than 250 employees. In columns (5)–(8), we restrict the sample to the frequent firms, *i.e.* those firms that trade FX OTC derivatives in at least two quarters of the sample period. The dependent variable is a binary variable that assumes value 1 if firm i and bank j agree on a FX OTC derivatives contract at day t. The other variables are defined as in the previous tables. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table A7: Summary Statistics – NDF Market (plain vanilla)

	Trades with one type of bank in the sample			Trades with two types of bank in the sample			Trades with two types of bank in the quarter		
	Obs	Mean	Std.Dev.	Obs	Mean	Std.Dev.	Obs	Mean	Std.Dev.
Number of employees	2280	404.44	1690.98	835	1280.63	3663.88	558	1716.17	4342.51
Firm's age (months)	2196	230.78	153.45	815	266.25	170.73	545	282.68	175.13
Total FX OTC notional (USD million)	2288	14.42	111.81	836	331.28	2399.67	558	484.84	2925.05
Importer (dummy)	2288	0.80	0.40	836	0.87	0.33	558	0.87	0.33
Exporter (dummy)	2288	0.39	0.48	836	0.59	0.49	558	0.67	0.47

Notes: This table summarizes the main characteristics of the sample of firms that traded plain vanilla NDF (contracts with only one settlement date, maturities ranging from 20 to 360 days and no customization features) from January/2010 to December/2014. We split the sample among three main groups: i) firms that trade derivatives with just one type of bank during the sample, *i.e.* firm that buy derivatives only from lending relationship or from non-lending banks; ii) firms that resort to both lending relationship and non lending banks along the entire sample period; and iii) firms that buy FX OTC derivatives from both types of banks in the same quarter (this group is a subset of the second group). A lending relationship bank is a bank with which the firm had any outstanding loan balance in the previous 12 months. Total FX OTC notional is the aggregate of all FX OTC derivatives traded by the firm in the last 12 months. We compute the number of employees, firm´s age (measured in months), total FX OTC notional, importer (dummy) and exporter (dummy) as the median values over the sample period.

Table A8: Comparing firms that trade NDFs only with lending relationship banks to firms that trade only with non-lending banks

	Relationship bank				Non relationship bank				Diff
	Obs	Median	Mean	Std.Dev.	Obs	Median	Mean	Std.Dev.	
Number of employees	1936	68.00	364.95	1477.48	344	102.50	626.66	2574.05	261.71**
Firm's age (months)	1872	194.25	229.73	151.83	324	198.75	236.83	162.60	7.10
Total FX OTC notional (USD million)	1940	0.11	8.80	77.52	348	0.50	45.79	218.30	36.99***
Importer (dummy)	1940	1.00	0.80	0.40	348	1.00	0.79	0.41	-0.01
Exporter (dummy)	1940	0.00	0.38	0.48	348	0.00	0.43	0.49	0.05

Notes: We compare firms that trade plain vanilla NDF (contracts with only one settlement date, maturities ranging from 20 to 360 days and no customization features) exclusively with lending relationship banks or exclusively with non-lending banks from January/2010 to December/2014. A lending relationship bank is a bank with which the firm had any outstanding loan in the previous 12 months. Total FX OTC notional is the aggregate of all FX OTC derivatives traded by the firm in the last 12 months. We compute the number of employees, firm's age (measured in months), total FX OTC notional, importer (dummy) and exporter (dummy) as the median values over the sample period.

Table A9: Effect of the lending relationship on derivatives price – Robustness check: controlling for previous derivatives relationship

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	-0.003	-0.007	0.005	-0.002				
	(0.006)	(0.004)	(0.007)	(0.006)				
Lending relationship (dummy) x small firms		0.012		0.032***				
		(0.010)		(0.011)				
Main bank (dummy)			-0.031***	-0.021**				
			(0.008)	(0.009)				
Main bank (dummy) x small firms				-0.044***				
				(0.010)				
Concentration of lending					-0.032***	-0.025***		
					(0.007)	(0.009)		
Concentration of lending x small firms						-0.019		
						(0.018)		
Log (Relationship length)							0.000	-0.001
							(0.001)	(0.001)
Log (Relationship length) x small firms								0.004
								(0.003)
Derivatives relationship (dummy)	0.053***	0.052***	0.053***	0.052***	0.054***	0.053***	0.056***	0.057***
	(0.015)	(0.012)	(0.015)	(0.012)	(0.015)	(0.012)	(0.016)	(0.013)
Derivatives relationship (dummy) x small firms		-0.001		-0.003		0.005		-0.004
		(0.028)		(0.028)		(0.028)		(0.031)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,986	23,848	23,986	23,848	23,969	23,831	23,505	23,367
Adjusted R^2	0.808	0.809	0.808	0.809	0.808	0.809	0.812	0.813

Notes: This table shows the results of the estimation of equations 3 and 4, controlling for previous relationship in the FX OTC derivatives market. We restrict the sample to the firms that traded plain vanilla NDF with both a lending relationship and a non-lending bank in the same quarter along the period from January 2010 to December 2014. The dependent variable is the NDF spread, which is measured as the percentage difference between the forward exchange rate and corresponding future price for the same contract maturity. We denote small firms as the firms with no more than 250 employees. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Log(Notional) corresponds to the natural logarithm of the notional value (in USD) of the contract and log(Maturity) is the natural logarithm of the maturity of the contract. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table A10: Effect of the lending relationship on the derivatives price – Robustness check: controlling for previous derivatives relationship and for the main derivatives supplier

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	-0.005	-0.008*	0.004	-0.003				
	(0.006)	(0.005)	(0.008)	(0.006)				
Lending relationship (dummy) x small firms		0.012		0.031**				
		(0.012)		(0.013)				
Main bank (dummy)			-0.031***	-0.021**				
			(0.008)	(0.009)				
Main bank (dummy) x small firms				-0.043***				
				(0.010)				
Concentration of lending					-0.033***	-0.027***		
					(0.007)	(0.009)		
Concentration of lending x small firms						-0.019		
						(0.020)		
Log (Relationship length)							0.000	-0.001
							(0.001)	(0.001)
Log (Relationship length) x small firms								0.004
								(0.003)
Derivatives relationship (dummy)	0.047***	0.047***	0.047***	0.047***	0.048***	0.048***	0.049***	0.051***
	(0.015)	(0.013)	(0.015)	(0.013)	(0.015)	(0.013)	(0.016)	(0.014)
Derivatives relationship (dummy) x small firms		-0.003		-0.004		0.001		-0.005
		(0.032)		(0.032)		(0.032)		(0.034)
Main Derivatives bank(dummy)	0.014**	0.014*	0.014**	0.014*	0.014***	0.013*	0.015***	0.016**
	(0.005)	(0.007)	(0.005)	(0.007)	(0.005)	(0.007)	(0.005)	(0.007)
Main Derivatives bank(dummy) x small firms		-0.001		-0.002		0.002		-0.003
		(0.019)		(0.018)		(0.018)		(0.017)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	23,986	23,848	23,986	23,848	23,969	23,831	23,505	23,367
Adjusted R^2	0.808	0.809	0.808	0.809	0.808	0.809	0.812	0.813

Notes: This table shows the results of the estimation of equations 3 and 4, controlling for previous relationship in the FX OTC derivatives market. We restrict the sample to the firms that traded plain vanilla NDF with both a lending relationship and a non-lending bank in the same quarter along the period from January/2010 to December/2014. The dependent variable is the NDF spread, which is measured as the percentage difference between the forward exchange rate and corresponding future price for the same contract maturity. We denote small firms as the firms with no more than 250 employees. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table A11: Summary Statistics – Comparing firms that trade with two types of banks and firms that trade with only relationship banks (NDF Market)

	Firm trades with both types of banks			Firm trades with two or more relationship banks		
	Obs	Mean	Std.Dev.	Obs	Mean	Std.Dev.
Number of employees	558	1716.17	4342.51	956	926.83	2882.68
Firm's age (months)	545	282.68	175.13	932	257.63	165.43
Total FX OTC notional (USD million)	558	484.84	2925.05	957	145.69	1304.23
Importer (dummy)	558	0.87	0.33	957	0.87	0.33
Exporter (dummy)	558	0.67	0.47	957	0.52	0.50

Notes: This table summarizes the main features of the sample of firms that traded plain vanilla NDF (contracts with only one settlement date, maturities ranging from 20 to 360 days and no customization features) from January 2010 to December 2014. We split firms in two groups: i) firms that buy FX OTC derivatives from both types of banks in the same quarter; and ii) firms that buy FX OTC derivatives from two relationship banks in the quarter. A lending relationship bank is a bank with which the firm had any outstanding loan balance in the previous 12 months. Total FX OTC notional is the aggregate of all FX OTC derivatives traded by the firm in the last 12 months. We compute the number of employees, firm´s age (measured in months), total FX OTC notional, importer (dummy) and exporter (dummy) as the median values over the sample period.

Table A12: Effect of lending relationship on the derivatives price – Sample of firms that trade with two or more relationship banks in the quarter

	(1)	(2)	(3)	(4)	(5)
Main lending bank (dummy)	-0.009	0.008			
	(0.008)	(0.009)			
Main lending bank (dummy) x small firms		-0.058***			
		(0.017)			
Concentration of lending			-0.006	0.021*	
			(0.015)	(0.010)	
Concentration of lending x small firms				-0.088**	
				(0.042)	
Log (Relationship length)					0.009
					(0.005)
Log (Relationship length) x small firms					-0.001
					(0.014)
Controls	Yes	Yes	Yes	Yes	Yes
Firm-Quarter FE	Yes	Yes	Yes	Yes	Yes
Bank-Day FE	Yes	Yes	Yes	Yes	Yes
Observations	21,618	21,517	21,618	21,517	20,907
Adjusted R^2	0.869	0.870	0.869	0.870	0.873

Notes: This table shows the results of the estimation of equations 3 and 4, using data from the sample of firms that traded plain vanilla NDF with two or more lending relationship in the same quarter along the period from January 2010 to December 2014. The dependent variable is the NDF spread, which is measured as the percentage difference between the forward exchange rate and corresponding future price for the same contract maturity. We denote small firms as the firms with no more than 250 employees. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Log(Notional) corresponds to the natural logarithm of the notional value (in USD) of the contract and log(Maturity) is the natural logarithm of the maturity of the contract. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table A13: Differences between the sample of firms that trade with two types of banks in a quarter and the remaining firms.

	Trades with two types of banks				Other Firms				Diff
	Obs	Median	Mean	Std.Dev.	Obs	Median	Mean	Std.Dev.	
Number of employees	841	414.00	2053.44	5925.80	5326	102.00	468.53	1723.88	-1584.91***
Firm's age (months)	834	243.75	290.95	174.63	5326	200.75	239.13	158.98	-51.82***
Importer (dummy)	843	1.00	0.87	0.34	5499	1.00	0.64	0.48	-0.23***
Exporter (dummy)	843	1.00	0.62	0.48	5499	0.00	0.35	0.47	-0.27***
Derivatives ratio	843	0.05	0.19	0.29	5437	0.00	0.04	0.15	-0.15***
NDF-to-total derivatives ratio	843	0.93	0.75	0.34	5499	0.96	0.64	0.43	-0.11***
Derivatives share with relationship banks	843	0.63	0.60	0.27	5499	1.00	0.83	0.34	0.23***
Derivatives share with the main bank	843	0.10	0.18	0.20	5499	0.11	0.39	0.44	0.21***
Maturity (days)	843	99.03	163.49	224.55	5499	180.00	287.96	314.02	124.47***
Notional (USD million)	843	2.18	9.16	28.67	5499	0.40	2.34	9.59	-6.82***

Notes: This table compares the mains descriptive statistics between the sample of firms employed in our empirical tests, *i.e.* firms that trade with at least two types of banks (lending relationship and non-lending banks) in the same quarter, and the remaining firms. Data at firm level from January 2010 to December 2014. We compute the number of employees, firm's age (measured in months), notional, and maturity as the median values over the sample period. The derivatives ratio is the proportion of FX derivatives outstanding with respect to the sum of FX derivatives' notional value and loan amount outstanding. The NDF-to-total derivatives ratio is the ratio of the notional value of FX NDF contracts to the total FX OTC notional amount traded between the firm and all the banks in the sample period. The derivatives share with lending relationship banks and derivatives share with the main bank are, respectively, the share of the FX OTC notional amount traded with all relationship banks and with the main bank in the sample period. A lending relationship bank is a bank with which the firm had any outstanding loan balance in the previous 12 months and the main bank is the bank among the relationship banks with which the firm maintained the largest lending outstanding balance in the previous 12 months.

Table A14: Impact of the intensity of lending relationship on notional value, maturity and contract customization: firms trading with two lending relationship banks in the quarter

	Notional		Maturity		Customization	
	(1)	(2)	(3)	(4)	(5)	(6)
Main lending bank (dummy)	0.052**	0.046	0.005	0.006	0.014	0.017
	(0.025)	(0.031)	(0.020)	(0.029)	(0.010)	(0.013)
Main lending bank (dummy) x small firms		0.015		-0.002		-0.006
		(0.047)		(0.037)		(0.016)
Firm-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Quarter FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,894	7,843	7,894	7,843	7,894	7,843
Adjusted R^2	0.860	0.861	0.805	0.805	0.775	0.776

Notes: This table shows the results of the estimation of equations 5 and 6, using data from the sample of firms that traded FX OTC derivatives with two or more lending relationship banks in the same quarter along the period from Jan/2010 to Dec/2014. The dependent variables are the natural logarithm of the quarter aggregated notional amount (in USD) (columns (1)–(2)), the natural logarithm of the derivatives maturity (in days) (columns (3)–(4)), and the share of customized FX OTC Contracts, defined as the sum of the notional amount of FX customized contracts over the total amount of notional of all FX contracts the firm traded with the bank in a quarter (columns (5)–(6)). We denote small firms as the firms with no more than 250 employees. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table A15: Effect of lending relationship intensity on the matching probability in the FX OTC derivatives market – Robustness check: firm-bank fixed effect

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	0.027***	0.015***	0.026***	0.014***				
	(0.004)	(0.003)	(0.004)	(0.003)				
Main bank (dummy)			0.006	0.006				
			(0.005)	(0.004)				
Concentration of lending					0.035**	0.025*		
					(0.017)	(0.013)		
Log (Relationship length)							0.005***	0.002***
							(0.001)	(0.001)
Derivatives relationship (dummy)		0.114***		0.114***		0.115***		0.114***
		(0.010)		(0.010)		(0.010)		(0.010)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Freq firms	Freq firms	Freq firms	Freq firms	Freq firms	Freq firms	Freq firms	Freq firms
Observations	2,743,930	2,743,930	2,743,930	2,743,930	2,743,930	2,743,930	2,739,165	2,739,165
Adjusted R^2	0.392	0.400	0.392	0.400	0.392	0.400	0.397	0.405

Notes: This table shows the results of the estimation of equation 2, using data from January/2010 to December/2014. We built a panel data that includes that includes all firms and banks that trade FX OTC derivatives on each day of the sample. As we control for firm-bank fixed effects, we restrict the sample to the frequent firms, *i.e.* those firms that trade FX OTC derivatives in at least two quarters of the sample period. The dependent variable is a binary variable that assumes value 1 if firm i and bank j agree on a FX OTC derivatives contract at day t. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.

Table A16: Effect of lending relationship on FX derivatives price according to firm size – Robustness check: firm-bank fixed effect

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Lending relationship (dummy)	-0.011	-0.012	-0.009	-0.009				
	(0.009)	(0.009)	(0.009)	(0.009)				
Main bank (dummy)			-0.015*	-0.015**				
			(0.007)	(0.008)				
Concentration of lending					-0.029**	-0.030**		
					(0.012)	(0.013)		
Log (Relationship length)							-0.002	-0.002
							(0.002)	(0.002)
Derivatives relationship (dummy)		0.014		0.015		0.015		0.016
		(0.014)		(0.014)		(0.014)		(0.014)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Day FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	42,162	42,162	42,162	42,162	42,096	42,096	41,352	41,352
Adjusted R^2	0.683	0.683	0.683	0.683	0.683	0.683	0.685	0.685

Notes: This table shows the results of the estimation of equation 4, using data from the sample of firms that traded plain vanilla NDF with the same bank in at least two quarters along the period from January 2010 to December 2014. The dependent variable is the NDF spread, which is measured as the percentage difference between the forward exchange rate and corresponding future price for the same contract maturity. We denote small firms as the firms with no more than 250 employees. The lending relationship is a binary variable equal to 1 if firm i had an outstanding loan balance with bank j in the previous 12 months and 0 otherwise. The concentration of lending is the proportion of the total borrowing of a firm supplied by a bank in the previous 12 months. Main bank is a dummy variable indicating, for each firm in each quarter, the bank with the largest concentration of lending. Log(Relationship length) is the natural logarithm of the number of months of the loan or deposit relationship between the bank and firm. Log(Notional) corresponds to the natural logarithm of the notional value (in USD) of the contract and log(Maturity) is the natural logarithm of the maturity of the contract. Heteroskedasticity-robust standard errors clustered at the bank level are shown in parentheses. The symbols *, **, and *** indicate statistical significance at 10%, 5%, and 1% levels, respectively.