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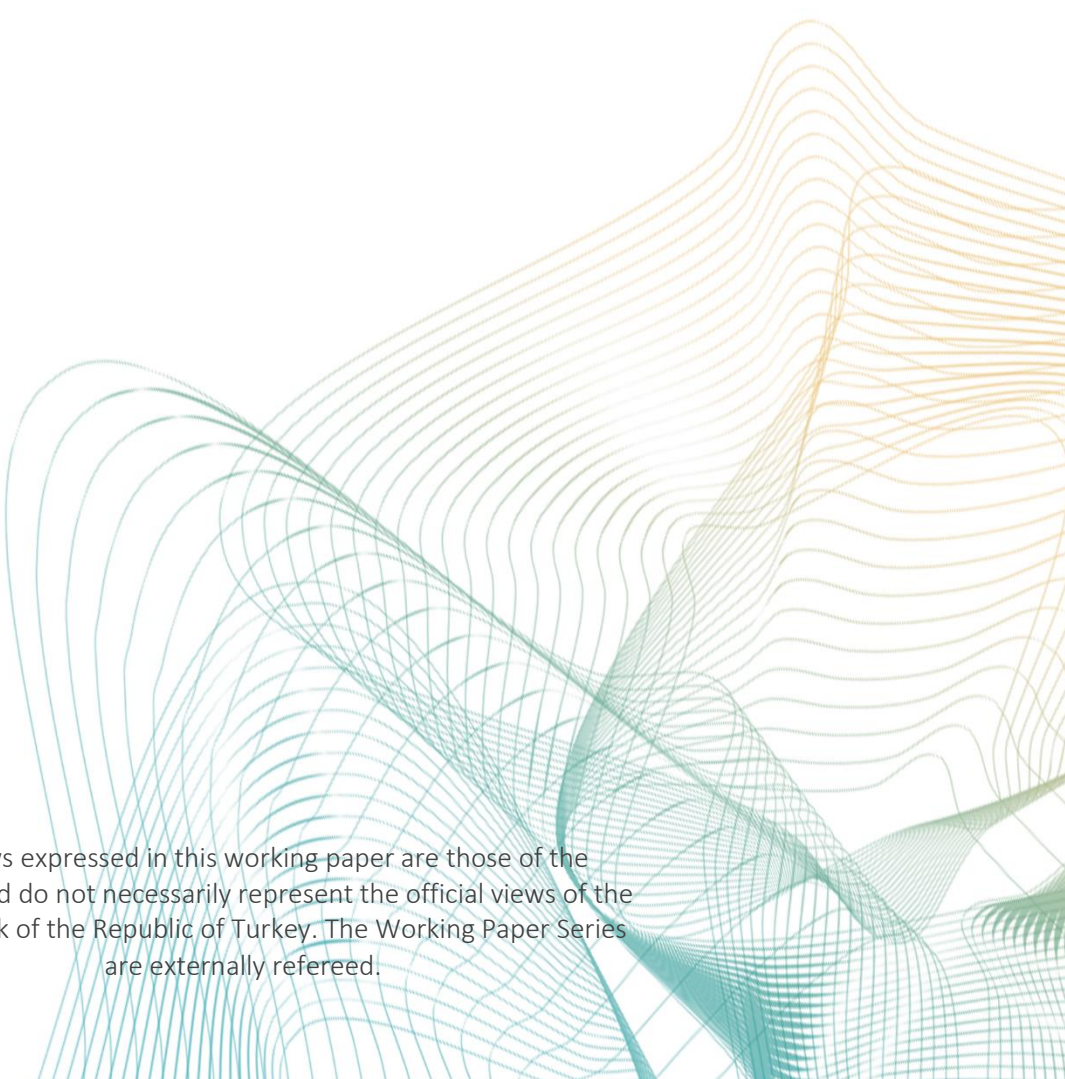
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Tracing the Impact of a Sudden Stop: The Role of Bank Rollover Risks, Expectations, and Domestic Production Networks[☆]

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Abstract

We show that ex-ante higher bank rollover risks in international wholesale markets and more pessimistic bank expectations about future foreign funding conditions significantly amplify the reduction in bank credit supply after a sudden stop. Moreover, the reduction in bank credit supply has cascading real effects through domestic production networks, amplifying the effect of credit crunch on investment. The mechanism is that suppliers ex-ante working more with global-liquidity-reliant banks reduce their supply of inputs to their downstream firms more after the sudden stop. For identification, we study comprehensive micro-level databases from Turkey, and exploit the sudden stop around “Lehman”.

Keywords: Sudden Stop; Credit Supply Channel, Domestic Production Networks, Emerging Market Economies.

JEL Codes: E44; F34; F41; L14.

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Executive Summary

An important channel through which a sudden stop (a sudden reversal of international capital inflows) affects local economic activity is the credit supply channel. A key finding from the extant literature is that banks that ex-ante rely on foreign funds that suddenly dries up reduce their supply of credit more strongly, and firms attached to more affected banks experience more adverse real outcomes (such as lower investment). In this paper, we show that it is not only banks' ex-ante reliance on global liquidity, but also having higher ex-ante rollover risks in international wholesale markets and being more pessimistic about future foreign funding conditions that drive the reduction in bank credit supply following a sudden stop. Moreover, the real effects of the sudden stop due to the reduction in bank credit supply propagate within the economy through firm-to-firm linkages. For identification, we exploit the sudden stop after the Lehman collapse, and use novel large-scale administrative databases from Turkey.

Briefly summarized, the results show that for a given ex-ante degree of reliance on global funding, banks with higher ex-ante rollover risks or more pessimistic expectations about future foreign funding conditions reduce their supply of credit to a given firm more strongly.

Moreover, the real effects of the credit supply channel propagate through firm-to-firm linkages. Firms that prior to the sudden stop work more with the 'exposed suppliers' reduce their tangible fixed capital investment more in the aftermath of the shock (where exposed suppliers are those that ex-ante borrow more from banks with higher ex-ante reliance of global liquidity). The mechanism is that suppliers that ex-ante borrow more from global-liquidity-reliant banks prior to the sudden stop reduce their supply of goods significantly more after the shock. Such downstream effects (the degree of exposed suppliers reducing their supply of goods) appears by an order of magnitude stronger than the upstream effects (the degree of exposed buyers reducing their demand for goods).

1. Introduction

An important channel through which a sudden stop (a sudden reversal of international capital inflows) affects local economic activity is the credit supply channel (see, e.g., [Schnabl, 2012](#); or more broadly, [Iyer et al. 2014](#); [Cingano et al. 2016](#); [Morais et al. 2019](#)). A key finding from this extant literature is that banks that ex-ante rely on foreign funds that suddenly dries up reduce their supply of credit more strongly, and firms attached to more affected banks experience more adverse real outcomes (such as lower investment). In this paper, we show that it is not only banks' ex-ante reliance on funding source that is hit (global liquidity for our case), but also having higher ex-ante rollover risks in international wholesale markets and being more pessimistic about future foreign funding conditions that drive the reduction in bank credit supply following a sudden stop. Moreover, the real effects of the sudden stop due to the reduction in bank credit supply propagate within the economy through firm-to-firm linkages (a point also largely overlooked in the literature). For identification, we exploit the sudden stop after the Lehman collapse, and use novel large-scale administrative databases from Turkey.

Our starting observation is that banks' supply of credit depends fundamentally on their expectation of and ability to access to liquidity ([Diamond and Rajan, 2006](#); [Allen and Gale, 2007](#)). From this point of view, banks' having or expecting greater difficulty in re-financing their maturing foreign debt during a sudden stop should also matter for their credit supply adjustments. In other words, focusing solely on banks' ex-ante reliance on global liquidity in fact underestimates their 'true' exposure.

Moreover, shocks to a firm do not get absorbed and end within the firm, but rather propagate through the firm's production network ([Acemoglu et al., 2016](#); [Barrot and Sauvagnat, 2016](#); [Tintelnot et al., 2017](#)), leading firms that are not directly exposed to the shock to be affected as well (the easiest way to think of such effects is to consider natural disasters that lead to a disruption in supply chains, as in, e.g., [Barrot and Sauvagnat \(2016\)](#), that spills over to firms even in unaffected areas). Nonetheless, the bank lending literature has so far been silent on such propagation of real effects, mainly due to lack of data –especially based on complete firm-to-firm linkages–.

We identify these channels by using large-scale administrative databases from Turkey. First, we use a novel register, the International Interbank Market Register –which provides transaction-level details about the universe of cross-border borrowing of banks operating in Turkey, with details including the volume of transaction, and loan origination and termination dates–. By using this register, we calculate for each bank a measure of rollover risk, which we define as the share of foreign-currency wholesale loans originated at least one year before the sudden stop and prescheduled to

mature at or shortly after the sudden stop, in proportion to total foreign-currency wholesale loans.¹

Second, we use a proprietary survey by the Central Bank of the Republic of Turkey (CBRT) on bank-level US dollar/Turkish lira exchange rate expectations, to gauge bank expectations about future foreign funding conditions.² Intuitively, a more depreciated domestic currency is associated with weaker inflows of capital, and banks that expect a weaker domestic currency over the near horizon would feel more stranded to expand credit (particularly, the banks that rely more on global liquidity, and more acutely so, if they also have higher rollover risks).

Third, we use the universe of firm-to-firm sales database (collected for value-added-tax purposes), and more crucially for our purpose, match this database with the domestic Credit Register.³ We, to our best knowledge, are the first to trace how real effects of a bank ‘liquidity shock’ (sudden stop) propagate within the economy through firm-to-firm linkages –especially based on granular data. Importantly, we are also able to identify the underlying mechanism (driving the downstream or upstream effects) by exploiting within-buyer or within-supplier variation in firm-to-firm sales across firms with different reliance on affected banks.

Finally, we study the domestic Credit Register –which provides bank-firm-loan-level details on the universe of corporate loans extended by all banks operating in Turkey–. To credibly identify credit supply (Khwaja and Mian, 2008; Jimenez et al., 2012), we exploit within-firm variation in the growth of credit granted by banks with different exposures to the sudden stop (where exposure is measured by banks’ ex-ante degree of rollover risks, exchange rate expectations, and reliance on global liquidity).⁴

¹Note that weaker banks may have (or be forced to have) shorter maturity cross-border loans, which in turn may face greater rollover risks during a sudden stop. So, focusing on cross-border loans that were scheduled to mature *long before* the sudden stop mitigates such potential endogeneity. See Almeida et al. (2012) for a similar identification strategy applied to non-financial firms’ investment in the US (see also Garicano and Steinwender (2016), Costello (2019)). For robustness, we also consider cross-border loans maturing at or shortly after the sudden stop, regardless of whether they are originated long before the sudden stop or right before.

²The CBRT collects, in the first two weeks of each month, data on exchange rate expectations of financial institutions and large non-financial corporations. The question states “What does your institution expect the USD-Turkish lira exchange rate to be at the end of current month, at the end of the current year, and after 12 months?”. We use bank-level 12-month-ahead expected depreciation of the Turkish lira against the USD, measured prior to the sudden stop (September 2008). The median responses are regularly made available to the public at <https://www.tcmb.gov.tr/wps/wcm/connect/EN/TCMB+EN/Main+Menu/Statistics/Tendency+Surveys/Survey+of+Expectations+Statistics/>.

³Turkey is among the very few countries for which firm-to-firm sales data is available. Other countries include Belgium (Dhyne et al., 2015), Chile (Huneus, 2018), and the US (for publicly listed firms) (Barrot and Sauvagnat, 2016), and it is studied within different contexts, such as international trade or natural disaster shocks.

⁴Note that factors that affect domestic banks’ access to foreign funding simultaneously affect borrowers (non-financial firms). For example, the domestic currency depreciation, which is particularly sharp during sudden stops, may deteriorate the strength of the firms’ balance sheets (particularly for firms with lower net foreign currency assets). Concurrently,

Turkey provides an excellent laboratory to identify these channels, not only by having administrative micro-level databases crucial for identification, but also that banks are the main funding source for firms (with equity financing playing a negligible role for the majority of firms). Moreover, global liquidity is an important funding source even for domestically-owned banks, comprising about 11% of their asset size. Indeed, concurrent with the drop in foreign-currency wholesale funding, we observe a sharp drop in aggregate credit after September 2008 (Figure 1(A)). As foreign wholesale funding came practically to a halt after September 2008, annual growth in aggregate domestic credit dropped from over 30% to almost nil within a year. Moreover, as Figure 1(B) suggests, banks that rely more on foreign wholesale funding prior to the sudden stop appear to provide less credit afterwards.

Our results show that, for a given ex-ante degree of reliance on global funding, banks with higher ex-ante rollover risks or more pessimistic expectations about future foreign funding conditions reduce their supply of credit to a given firm more strongly. The effects are sizeable: an estimated 10.6% stronger reduction in credit supply by banks with higher rollover risks, and 3.7% by more pessimistic banks (with stronger effects for banks with higher rollover risks *and* more pessimistic expectations).⁵ Moreover, consistent with the previous literature, we find that banks with higher ex-ante reliance on global funding cut their supply of credit more following the sudden stop (economically, by 13% for banks at the third vs. the first quartile of the distribution of foreign funding ratio).⁶ Finally, the reduction in credit supply by high rollover risk or more pessimistic banks is higher for weaker firms (smaller, short-term indebted or non-exporters), and firms ex-ante working more with the affected banks face binding financial constraints –which in turn, entails adverse ‘direct’ real effects, such as lower operating profits (by 2%) or lower investment (by 3%). We find the marginal effect of firms’ ex-ante working more with high rollover risk or more pessimistic banks –on top of working more with banks with high reliance on global funding– negligible.

Moreover, there is strong evidence that real effects of the credit supply channel propagate through firm-to-firm linkages. Firms that prior to the sudden stop work more with the ‘exposed suppliers’ reduce their tangible fixed capital investment more in the aftermath of the shock (where exposed suppliers are those that ex-ante borrow more from banks with higher ex-ante reliance of global liq-

gloomy economic prospects adversely affect firms’ expected income stream and deteriorate their perceived ability to pay their debts back. Therefore, it is important to credibly abstract away from demand-side effects. We do so by focusing on within-firm variation (and focusing on multiple-bank firms).

⁵We have used interquartile ranges for each bank variable to calculate the economic impacts.

⁶We use foreign funding ratio or the degree of reliance on global liquidity interchangeably throughout the text.

uidity). From an economic magnitude standpoint, the estimated impact on investment of working more with exposed suppliers is sizeable, from one-tenth to one-fourth of the direct channel.

We then identify the mechanism by exploiting within-buyer variation in firm-to-firm sales. We show that, for a given firm working with at least two suppliers prior to the sudden stop, more exposed suppliers reduce their supply of goods significantly more after the shock (economically, a supplier at the third quartile of the distribution of the firm-level exposure to the sudden stop reduces its supply of goods by 2.4% more compared to a supplier at the first quartile). This result holds when we focus on suppliers operating within the same industry and city for a given buyer (thus, the goods supplied are more likely to be similar, with similar transportation costs incurred). Moreover, for firms having more concentrated supplier markets, indirect effects on investment are estimated to be twice stronger.⁷ Finally, the estimated downstream effect (the degree of exposed suppliers reducing their *supply* of goods) appears by an order of magnitude stronger than the upstream effect (the degree of exposed buyers reducing their *demand* for goods).

Our paper contributes to a large body of literature on the international transmission of financial shocks, and more generally, on the real effects of credit supply shocks. It is shown that following an adverse liquidity shock emanating from outside or within the economy, banks that rely on such funds and cannot easily substitute them with other funding sources are shown to transmit the shock more strongly to their clients (firms). In turn, firms attached to these banks experience more adverse financial or real outcomes. Examples include [Peek and Rosengren \(1997, 2000\)](#), [Schnabl \(2012\)](#), [Cetorelli and Goldberg \(2012a,b\)](#), [Iyer et al. \(2014\)](#), [Chodorow-Reich \(2014\)](#), [Ongena et al. \(2015\)](#), [Cingano et al. \(2016\)](#), [Bentolila et al. \(2018\)](#), [di Giovanni et al. \(2018\)](#), [Morais et al. \(2019\)](#). [Table 1](#) presents a non-exhaustive list of related papers, particularly on the international transmission of financial shocks, including details such as the nature of the shock and the aggregation level of data studied.

Our main contribution is twofold: First, we uncover two significant sources of contraction in credit supply following a sudden stop. Namely, we show that it is not only the degree of banks' ex-ante reliance on a funding source that strongly dries up (as was taken in the previous literature), but also their rollover risks and expectations about future funding conditions that matter for the subsequent drop in credit supply. These additional channels amplify the reduction in local credit supply during the sudden stop in a significant and economically sizeable way. Second, we show

⁷The indirect effect is nearly twice as large for a downstream firm at the 75th percentile of the distribution of supplier market concentration, compared to a downstream firm at the 25th percentile.

that the real effects of contraction in bank credit supply propagates through buyer-supplier linkages (namely, significantly lower supply of inputs by more exposed suppliers, and significantly lower investment by firms that ex-ante work more with the exposed suppliers).

Our paper is also related to the recently growing literature on domestic production networks (see, e.g., [Barrot and Sauvagnat, 2016](#); [Tintelnot et al., 2017](#); [Huneus, 2018](#)). Unlike real shocks such as natural disasters or trade shocks as studied in this strand of literature, here we focus on a financial shock (the sudden stop) –and how it propagates within the economy through production networks.⁸ Our paper, in this regard, complements [Costello \(2019\)](#) and [Alfaro et al. \(2019\)](#). [Costello \(2019\)](#) show for the US that suppliers with larger share of long-term debt to mature at the onset of the US financial crisis reduce the volume of trade credit extended to their customers more –which in turn lowers their customers’ employment levels. [Alfaro et al. \(2019\)](#) combine the industry-level input-output structure in Spain with the credit register, and report sizeable direct and indirect real effects of firm-level credit supply shocks. They shed light on the driving force for downstream effects by focusing on firm-level changes in accounts payable. By using the *granular input-output structure* at the buyer firm-supplier firm level for the universe of firms –matched with the universe of bank-firm loan information via the credit register–, we offer sharper inferences, and further, identify the mechanism that drives downstream effects by exploiting within-buyer variation in sales by suppliers with different exposures to the sudden stop.

The paper proceeds as follows: Section 2 presents details about the databases. Sections 3 and 4 provide empirical strategy and the results, the former on the credit supply channel, and the latter on the direct and indirect real effects of the credit supply channel. Section 5 concludes.

2. Databases

Credit Register. The Credit Register of Turkey provides confidential and detailed information about the universe of loans granted by all banks operating in Turkey. The register is maintained and supervised by the Banking Regulation and Supervision Agency (BRSA), the authority in charge of supervising the banking sector in Turkey. Banks are obliged to report their credit granted (credit limits) and outstanding loan balances at a given month for each firm for different loan types (domestic vs. foreign currency denominated, cash vs. non-cash, short-, medium- or long-term term –based on original maturity–). The Credit Register is exhaustively comprehensive, as there is practically no

⁸We provide a detailed review of the literature in [Appendix A](#).

reporting threshold.⁹

We focus on the period of September 2008 to September 2009, the former coinciding with the Lehman Brothers' collapse and the latter by and large coinciding with the lowest annual growth in aggregate domestic credit after September 2008 (Figure 1(A)). We exclude foreign-owned banks, as the ex-ante reliance on foreign funding, rollover risks in international wholesale markets or expectations about future funding conditions –the key channels through which we trace the impact of the sudden stop– should matter particularly for domestically-owned banks. We further exclude participation/Islamic banks, as they comply with different lending standards. In sum, we cover a large share (75%) of total banking sector credits during our sample period.

We aggregate the register at the firm-bank-currency-type level for each month (our baseline level of aggregation). In total, we have 267,328 firms (or 102,577 firms with multiple banking relationships), 2 types of loans (domestic and foreign-currency denominated), and 20 banks. Our results are strongly robust to using the data set at its most disaggregated level (bank-firm-loan-type level) or at the bank-firm level, as we report below.

International Interbank Market Register. This register, maintained and supervised by the BRSA, provides transaction-level details about the universe of cross-border borrowing by all banks operating in Turkey. The details include unique borrower and lender identifiers, lender bank's country (and its headquarter's country), volume, interest rate, currency of denomination, and origination and termination dates for each transaction. Transactions involve cross-border loans –which we focus on– and deposits. By using this register, we calculate bank-level rollover risks (by using loan volumes and origination and termination dates).

For the baseline measure of rollover risk, we take the ratio of cross-border foreign-currency loans originated at least one year before September 2008 and that is going to mature within 8 months after September 2008 to total cross-border foreign-currency loans. For an alternative measure, we use cross-border foreign-currency loans that is going to mature within 8 months after September 2008 –regardless of whether their origination is long before the sudden stop or not–.

Figure 2 presents the histogram of bank ex-ante rollover risks (for the baseline and the alternative). For both measures, we observe a large dispersion across banks (with the latter exhibiting a larger dispersion). Baseline rollover risk is 12% on average, and ranges between zero and 26%. The alternative measure of rollover risk is higher (as expected) and 42% on average, and ranges between zero to 100%.

⁹The results are robust if we exclude loans below a certain threshold, e.g., 1,000 TRY or 5,000 TRY.

CBRT Survey of Exchange Rate Expectations. In the first two weeks of each month, The Central Bank of the Republic of Turkey (CBRT) collects survey data on what financial institutions or large non-financial corporates expect the USD/TRY exchange rate to be in the following months. The question, in particular, states “*What does your institution expect the USD-Turkish lira exchange rate to be at the end of current month, at the end of the current calendar year, and after 12 months?*” We take 12-month-ahead bank expectations measured prior to the sudden stop (during early September 2008).¹⁰

Banks on average expect a 7% depreciation of TRY against USD (which roughly reflects Turkey vs. US inflation differential at the time), and there exists sizeable heterogeneity -as shown by the histogram of expected depreciation across banks (Figure 3). The expected depreciation ranges between -1% to 10%. Moreover, bank expectations appear significantly persistent.¹¹

Bank Balance Sheets/Income Statements. For bank controls, we use supervisory monthly bank balance sheets (disaggregated at domestic and foreign-currency denominated items) and income statements databases, provided by the BRSA. We further use the BRSA’s supervisory monthly Tier-1 capital database to obtain bank capital adequacy ratios. In sum, our bank controls are capital adequacy ratio (Tier-1 capital-to-total risk-weighted assets), liquidity ratio (ratio of total liquid assets-to-total assets)¹², size (log total assets), profitability (return on assets)¹³, and non-performing loans ratio (the ratio of total non-performing loans-to-total loans (NPL)). One of our key variables, banks’ ex-ante reliance on foreign funding is defined as the ratio of non-core foreign-currency liabilities to total assets.¹⁴ All of our bank-level variables are measured ex-ante (September 2008).

Firm Balance Sheets/Income Statements. We have access to complete balance sheets and income statements for the universe of firms (excluding single employee/entrepreneurial firms), provided by Turkish Statistical Institute. Since the dataset is annual, we use end-of-2008 and end-of-2009 infor-

¹⁰Longer term (e.g., 12-month-ahead) expectations about future funding conditions may better explain how foreign-funding-reliant banks adjust their supply of credit, as compared to shorter term expectations (e.g. year-end, which in our case is 3-months-ahead). Our results are strongly robust to using year-end expectations (not reported for brevity).

¹¹In particular, based on a sample running from January 2007 to September 2009, we regress bank FX expectations (12-month-ahead expected USD/TRY exchange rate) on its own lag, the median expectations, and lagged bank controls (Table 2). It appears that lagged own expectations is a robust and significant (at .01 level) predictor of current expectations (with a persistence coefficient about 0.45). Larger or more profitable banks in general hold more pessimistic expectations, and median expectations seem to matter.

¹²Total liquid assets is the sum of cash, receivables from the central bank, receivables from interbank money market, and receivables from reverse repo.

¹³Return on assets is defined as 12-month moving average of pre-tax net profit in proportion to total assets.

¹⁴Non-core foreign-currency (FX) liabilities is the sum of FX payables to banks, FX payables to money and securities markets, FX funds from repo transactions and net FX securities issued. Throughout the text, we use non-core foreign-currency liabilities and foreign wholesale funding interchangeably.

mation. To avoid misreporting or measurement errors, we exclude very small firms (those with total assets less than 1000TRY (800 USD)), firms with negative capital, and firms with negative bank deposits. In this final sample, we have detailed balance sheet and income statement information (together with their NACE4-industry codes and city of location) for over 90% of firms present at the Credit Register.

Firm-to-Firm Sales. We use monthly domestic firm-to-firm sales database provided by the Turkish Ministry of Treasury and Finance. The reported sales are based on invoices for value-added tax purposes. It provides unique buying and selling firm identifiers (matched with the credit register and firm balance sheets/income statements databases), and covers all firm-to-firm transactions above a modest threshold, 5000 TRY (\sim 4000 USD). The dataset provides the total invoice, without details on items in the invoice (similar to the few countries for which this type of database is available). Out of 234,958 firms present at the Credit Register for which we have complete balance sheets, 148,091 firms are buying from at least one domestic supplier. Total number of suppliers to these firms is 256,423.

Table 3 presents detailed definitions and the summary statistics of all the variables used in the empirical analyses.

3. Credit Supply Channel during the Sudden Stop: Identifying the Role of Bank Rollover Risks and Expectations

3.1. Empirical Strategy

To identify the credit supply channel, we exploit within-firm variation by saturating the model with firm fixed effects and study firms with multiple banking relationships (Khwaja and Mian, 2008). Namely, for a given firm, we compare the change in credit granted from before to after the sudden stop by banks with different ex-ante levels of (i) reliance on foreign funding, (ii) rollover risks, or (iii) expectations about future foreign funding conditions. Formally, we estimate

$$\begin{aligned} \Delta L_{bfc,post} = & (\beta_0 + \beta_1 \text{Rollover Risk}_{b,pre} + \beta_2 \text{FX Expectations}_{b,pre}) \text{Foreign Funding}_{b,pre} + \dots \\ & + \alpha_1 \text{Rollover Risk}_{b,pre} + \alpha_2 \text{FX Expectations}_{b,pre} + \alpha_3 X_{bf,pre} + \dots \\ & + \text{Bank Controls}_{b,pre} + \mu_f + \zeta_c + \varepsilon_{bfc,post} \end{aligned} \quad (1)$$

where $\Delta L_{bfc,post}$ is the log change in the credit granted by bank b to firm f in currency type c from September 2008 (*pre*) to September 2009 (*post*).¹⁵ Foreign Funding is the ratio of total foreign

¹⁵The Credit Register originally provides credit balances in domestic currency terms (regardless of whether the loan is

wholesale funding-to-total assets ratio. We cluster standard errors at the firm level.¹⁶

Our first focus variable is Rollover Risk. It is defined as the long-term (>1 year) foreign wholesale debt that is going to mature shortly after the sudden stop in proportion to total foreign wholesale borrowing. By “shortly after”, we consider 8 months as the baseline (October 2008-May 2009), and different horizons (4 to 7 months) for robustness. To mitigate potential endogeneity (e.g., riskier/weaker banks may be forced to have shorter maturity borrowing from abroad), we take *long-term* foreign borrowing, i.e., those that originated at least one year before the sudden stop, which happens to mature at or shortly after the sudden stop. The key idea is that banks that are going to experience maturing foreign debt during the sudden stop would face greater difficulty in rolling over their debt (and hence be less able to continue financing their lending activities as they used to). Alternatively, we study total (rather than just long-term) foreign wholesale debt that matures shortly after the sudden stop in proportion to total foreign wholesale borrowing, as robustness.

Our second focus variable is FX Expectations. It is defined as the log difference between 12-month-ahead expected USD/TRY exchange rate and the actual rate. A higher positive value means that the bank expects a stronger depreciation in the TRY against the USD, reflecting their expectations of less favorable foreign funding conditions.

We are primarily interested in, for a given ex-ante degree of reliance on foreign funding, whether banks with higher ex-ante rollover risks or banks that expect less favorable foreign funding conditions reduce their credit supply more. That is, we mainly focus on the coefficients β_1 and β_2 , alongside β_0 , and test whether they obtain negative values in a statistically significant and economically relevant way. The reason for focusing on the interaction variables is that bank rollover risks and expectations should matter particularly for banks that ex-ante rely more on foreign funding. For instance, for a bank with a negligible degree of reliance on foreign funding, having high rollover risks in foreign wholesale markets or expecting less favorable foreign funding conditions should play a weak role for its subsequent credit supply adjustments.

$X_{bf,pre}$ proxies the strength of the bank-firm relationship, namely the ratio of outstanding balance of firm f at bank b to total outstanding bank loans of the firm before the sudden stop. Bank Con-

classified at the Register as domestic or foreign currency denominated). Since the Turkish lira depreciated sharply after September 2008, that would imply a spurious increase in foreign currency loan balances. Therefore, we express foreign currency loan balances in foreign currency units (by using monthly average exchange rates based on an equal basket of USD/TRY and EUR/TRY exchange rates). Moreover, given a non-negligible level of inflation during our sample period (we observe a 5.3% increase in the headline CPI from September 2008 to September 2009), we express the nominal credit balance for domestic currency loans in real terms (using headline CPI).

¹⁶The results are strongly robust to clustering at the bank level, with the estimated coefficients remain significant at .01 level as in the baseline firm-level clustering.

trols, also measured ex-ante, are capital adequacy ratio, liquidity ratio, size, profitability, and non-performing loans ratio. μ_f stand for firm fixed effects (included for identification), and ζ_c currency-type fixed effects (where a loan is either domestic- or foreign-currency denominated).

Extensions. We extend the baseline analysis on various grounds.

First, we also conduct the analyses at the bank-firm level (with appropriate exchange rate adjustment in place).¹⁷ Moreover, equation (1) focuses on the intensive margin, i.e., firms that are granted a loan from a bank with the same currency type (domestic or foreign) for both periods, overlooking the possibility that firms may switch fully from one currency type to another at a given bank. Our analysis at the bank-firm level addresses this concern as well. Finally, we explore the very same question, again at the bank-firm level, for the extensive margins (the new lending and termination margins).

Second, we explore heterogeneity across firms in the reduction of credit supply. For example, and as also shown in the previous literature, smaller firms in general face a stronger reduction in credit supply by more affected banks following unfavorable liquidity shocks (see, e.g., [Khwaja and Mian, 2008](#); [Iyer et al., 2014](#)). Our analyses further assess whether this result holds as well for higher rollover risk or pessimistic banks (including studying a wider set of firm characteristics). Along this vein, we augment equation (1) with firm variables, by interacting our focus variables, the interaction of bank foreign funding with rollover risk or FX expectations, with each respective firm variable.

Third, we study whether the change in credit supply is binding at the firm level. We first calculate firm-level weighted average of bank foreign funding (average foreign funding of banks the firm was working with prior to the sudden stop, with weights proportional to the share of the bank's credit in total bank credit of the firm), weighted average of the interaction of bank foreign funding with rollover risk, and of bank foreign funding with FX expectations. We do the same calculation for all bank controls (capital ratio, liquidity ratio, size, etc.). In sum, we have all variables in equation (1)

¹⁷Note that aggregating bank-firm-currency level data at the bank-firm level requires exchange rate adjustment. For instance, a firm having foreign-currency denominated loans would have a higher loan balance in domestic currency terms after a domestic currency depreciation. That increase in loan balance would spuriously imply an increase in credit. Accordingly, when we aggregate the bank-firm-currency level data at the bank-firm level, we calculate foreign currency loans evaluated at the previous period's exchange rate (the loan balance if the exchange rate were not changed from September 2008 to September 2009). We then sum up exchange-rate-adjusted foreign currency loans and domestic currency loans at the bank-firm level. This procedure is essentially what the Central Bank of the Republic of Turkey follows when reporting aggregate exchange-rate-adjusted credit growth. For instance, suppose a firm has 50 TRY and 200 TRY worth of foreign-currency loan balances at a bank, and assume that the exchange rate is 1. In the next period, assume the TRY depreciated and the exchange rate raises to 2. Without any exchange rate adjustment (and ceteris paribus), that would imply firm's loan balance at the bank would go from $50\text{TRY}+(200\text{USD}\cdot 1)=250\text{TRY}$ to $50\text{TRY}+(200\text{USD}\cdot 2)=450\text{TRY}$. With the exchange rate adjustment, loan balance in the second period would be $50\text{TRY}+(200\text{USD}\cdot 2)\cdot(\text{First Period Exchange Rate}=1)/(\text{Second Period Exchange Rate}=2)=250\text{TRY}$, the same as in the first period.

aggregated at the firm level with appropriate weighting. Moreover, we follow [Jimenez et al. \(2018\)](#) to account for a potential bias in the firm-level regressions.

3.2. *Baseline Results*

Table 4 presents the baseline results. We start with the universe of firms regardless of whether they work with a single bank or multiple banks, and study a modest specification that includes bank foreign funding, without additional controls or fixed effects (column (1)). In column (2) and onwards, we focus on firms with multiple banking relationships and saturate the model with firm and currency-type fixed effects. As we proceed, we successively interact bank foreign funding with bank rollover risk or foreign exchange rate expectations, and include control variables (bank controls and a proxy for the strength of the bank-firm relationship).¹⁸

Our key finding is that banks' ex-ante rollover risk and expectations about future funding conditions significantly matter for change in their credit supply after the sudden stop.

In particular, we first establish that banks with higher ex-ante reliance on foreign funding reduce their supply of credit more strongly for a given firm (the first row). This essentially confirms what has already been shown by the literature on how liquidity shocks may affect bank lending, reporting stronger drop in credit supply for banks with higher ex-ante reliance on funding source that is hit.

In columns (3) and (4), we introduce bank rollover risk into the picture, and show that it emerges as a significant and economically relevant amplification factor for the reduction in bank credit supply. Namely, we find that foreign-funding-reliant banks with higher rollover risks cut their lending for a given firm significantly more compared to otherwise-similar banks with lower rollover risks (as given by the negative and statistically significant coefficient for the interaction of foreign funding with rollover risk).

Column (5), where we include banks' expectations about future funding conditions, points to a similar result. We find that banks that ex-ante rely on foreign funding and expect less favorable foreign funding conditions reduce their supply of credit more strongly for a given firm (as given by the negative and statistically significant coefficient for the interaction of foreign funding with FX expectations).

¹⁸In reporting economic impacts (lower panel of the table), we multiply the estimated corresponding coefficient with the interquartile range(s) of the respective variable(s). To ease interpreting the results, we label a bank (i) that ex-ante relies more on foreign funding as a high foreign funding bank, or (ii) that has a higher share of long-term foreign wholesale funding to mature within 8 months after the sudden stop to its total foreign wholesale funding as a high rollover risk bank, and (iii) that expects less favorable foreign funding conditions as pessimistic, if its foreign funding, rollover risk or FX expectations is at the 3rd quartile of the distribution of the respective variable. We then report the estimated economic impacts for 3rd versus 1st quartile of the distribution of foreign funding, rollover risk or expectations.

Column (6) includes both bank rollover risks and expectations. We continue to find that banks that are more reliant on foreign funding and hold a greater share of maturing foreign liabilities (higher rollover risks) or expect less favorable foreign funding conditions reduce their supply of credit more strongly for a given firm.

Our results are economically relevant. Considering economic impacts for the most saturated specification (column (6)), banks with higher ex-ante reliance on foreign funding reduces its credit supply by 13% more. For foreign-funding reliant banks with higher rollover risks or more pessimistic expectations, the reduction in credit supply is estimated to be 10.6% and 3.7%, respectively. Given that the aggregate growth of bank credit to non-financial corporates declined from over 35% in September 2008 to almost nil in September 2009, our estimated effects appear large and economically relevant.

Column (7) further includes the triple interaction of bank foreign funding, rollover risks and FX expectations. Intuitively, banks with greater reliance on foreign funding and higher rollover risks would be most stranded if they also expect less favorable foreign funding conditions. Our estimated (and significant) coefficient for the triple interaction confirms that this is the case. For a given firm borrowing from at least two banks with similar ex-ante levels of reliance on global liquidity and rollover risks, more pessimistic banks reduce their supply of credit by 5.5% more.¹⁹

In columns (8) and (9), we explore within firm-currency variation. Note that banks that ex-ante rely more on global liquidity may tend to extend foreign currency loans more (for completeness that may also apply for banks with higher/lower rollover risks or more/less pessimistic expectations), and the sharp currency depreciation during the sudden stop may reduce demand for foreign currency loans. Then, even in the absence of a credit supply channel, one can observe lower credit by high foreign funding banks.

To address this concern, we saturate the model with firm×currency fixed effects that ensure comparison of the *same* loan type (domestic- or foreign-currency) and the *same* firm across banks with different exposures to the sudden stop. A potential limitation of this specification is that not all firms may borrow in the same currency from multiple banks. Fortunately in our sample, such firms are not prevalent: our sample size drops only mildly (from 292,717 to 281,960). Our previous results hold: banks with higher foreign funding or foreign-funding-reliant banks with higher rollover risks or more pessimistic expectations reduce their supply of credit more strongly (column (8)), and more

¹⁹To reach this estimate, we subtract the estimated degree of reduction in credit supply by high foreign funding banks with high rollover risks (15.2%) from the estimated degree of reduction in credit supply by high foreign funding banks with high rollover risks and more pessimistic expectations (20.7%).

pessimistic expectations exacerbate the effect on the credit supply of bank rollover risks (column (9)). The economic impacts are also similar in magnitude.

3.3. Different Levels of Aggregation and Binding Reduction in Bank Credits

We now re-estimate our baseline specification at the bank-firm level. This is mainly for two reasons. First, firm is a unique entity that bears all the risks attached to its operations and banks evaluate the firm as a whole in deciding how much to supply credit. Second, a firm may fully switch from one currency type to another within a bank, a possibility that the baseline analyses overlook.

Table 5 shows that our previous results continue to hold at the bank-firm level (Panel (A)). Banks with higher ex-ante reliance on foreign funding, or foreign-funding-reliant banks with higher rollover risks or more pessimistic expectations reduce their supply of credit more strongly for a given firm (columns (2) and (4)). The economic impacts are similar to what we find earlier, and continue to be sizeable. In columns (1) and (3), we report the results based on specifications without firm fixed effects, which would be helpful shortly below.

Table 5 further shows that the reduction in bank credit supply is binding at the firm level (Panel (B)). If firms were able to fully offset the reduction in credit supply by more affected banks by borrowing more from (or switching to) less affected banks, our results above would not be of great relevance for aggregate effects. A proper assessment in this regard requires a firm-level analysis. We find that firms that ex-ante and on average work more with banks with higher ex-ante reliance on foreign funding, or with foreign-funding-reliant banks with higher rollover risks or more pessimistic expectations, experience a significantly higher reduction in total bank credit.

This result does not immediately mean that the reduction in total bank credit at the firm-level is due to the decline in bank credit supply, particularly if firms with lower credit demand happen to work more with affected banks. Jimenez et al. (2018) offers a way to adjust the bias that may occur due to firm-level credit demand (which can be backed out from the bank-firm-level regressions with and without firm fixed effects). Following this route, we find that our results remain intact, with estimated coefficients closer to the previous estimates even after the proposed adjustment (columns (5) and (6)).²⁰

²⁰In particular, the generic form for the bias-adjusted coefficient is $\beta = \hat{\beta}_{OLS}^{Firm} - \left(\hat{\beta}_{OLS}^{BankFirm} - \hat{\beta}_{FE}^{BankFirm} \right) * \frac{Var(\delta_i)}{Var(\bar{\delta}_j)}$, where $Var(\delta_i)$ is the variance of bank shocks (e.g., bank foreign funding, in our case), and $Var(\bar{\delta}_j)$ is the variance of firm-level averaged bank shocks (e.g., weighted average bank foreign funding).

3.4. Further Discussions and Robustness

3.4.1. Balancedness

Note that if the sudden stop affects not only banks, but also firms through other channels (which is quite plausible considering aggregate demand, balance sheet or trade channels) *and if* there exists an assortative matching between banks and firms, then our coefficients of interest will be biased. In this section, we explore such an identification concern.

Namely, we first study ex-ante loan portfolio characteristics of banks by comparing the cross-correlation of bank foreign funding, rollover risk, or FX expectations with the average characteristics of firms that exist in banks' loan portfolios prior to the sudden stop (Table 6). In particular, for each bank, we calculate weighted average firm size, inverse leverage, export-to-sales ratio and short-term indebtedness (short-term debt-to-total debt) –the firm variables that we also use in the remaining analyses– and firm past and future loan default indicators, using weights based on the share of each firm in the bank loan portfolio.

We find that bank loan portfolios are by and large balanced (Table 6). Most cross-correlations are small or insignificant at conventional values. For correlations that appear economically large, they imply that higher foreign funding banks are more likely to have larger or less risky firms in their loan portfolios. This essentially strengthens our results, given that such firms are generally affected less adversely during periods of unfavorable market liquidity conditions. Pessimistic banks on average have smaller yet less short-term indebted and less leveraged firms in their loan portfolios. For rollover risk, the cross-correlations are all insignificant and much smaller in magnitude. Overall, there is not strong evidence that banks that reduce their supply of credit more work systematically with weaker firms.

A indirect test of whether an assortative matching between banks and firms is at play and potentially alters our results is due to [Jimenez et al. \(2018\)](#). As we studied in Table 5, estimated coefficients based on firm fixed effects do not differ much from the estimated coefficients based on ordinary least squares (column (1) vs. column (2), and column (3) vs. column (4)), supporting balancedness of our data. A further finding that supports balancedness is that our results are robust to saturating the model with firm×currency fixed effects (Table 4).

We further report whether banks with higher foreign funding, rollover risks, or pessimistic expectations differ in terms of key bank characteristics such as capital adequacy, liquidity, size, etc. (Table 7). Higher foreign funding banks are in general smaller. Moreover, higher rollover risk banks are on average larger (potentially due to these banks being more able to borrow longer term from

abroad). Our controlling for bank size, and as will be evident below, finding robust evidence for when we use an alternative measure for rollover risk -which includes short-term foreign wholesale funding as well– suggest that this is less of an issue (see Tables 10 and 11). We find no significant or strong correlation between key bank characteristics and their FX expectations.

3.4.2. Extensive Margins

Another margin of adjustment for banks is to decide whether to start a lending relationship after the sudden stop with a firm that they were not previously working with, or whether to terminate an existing relationship with an existing firm after the sudden stop. We label these margins as “new lending” and “termination”, respectively.

We substitute the dependent variable in our baseline specification with (i) $\mathcal{N}_{bf,post}$, an indicator variable for new lending that takes a value 1 if bank b was not working with firm f prior to the sudden stop but establishes a new lending relationship with the firm in the aftermath; or (ii) $\mathcal{T}_{bf,post}$, an indicator variable for termination that takes a value 1 if bank b was working with firm f prior to the sudden stop but terminates that relationship with the firm afterwards. For the new lending regressions, $X_{bf,pre}$, the strength of the bank-firm relationship is naturally excluded, since it does not exist ex-ante.

Table 8 shows that extensive margins of credit supply point to a consistent picture with the intensive margin. Foreign-funding-reliant banks with higher rollover risks or more pessimistic expectations are less likely to establish a new lending relationship with a given firm, and are more likely to terminate their existing relationships. Comparing the economic impacts for the most saturated specifications which ranges from 0.8% to 3.1% (see columns (4) and (8)) with the unconditional averages of new lending and termination probabilities (which are 15% and 21%, respectively), the effects appear sizeable.

3.4.3. Alternative Measures for Bank Rollover Risks

So far, we measure bank rollover risks as the ratio of long-term foreign wholesale funding that is going to mature within $k = 8$ months after the sudden stop to total foreign wholesale funding. We now show that our results are robust to assuming alternative time horizons, i.e., $k = 4, 5, 6$ or 7 months (Table 9). We continue to find that foreign-funding-reliant banks with higher rollover risks reduce their supply of credit more strongly for a given firm. We do not find a clear pattern for whether rollover risks with shorter horizons matter differently compared to those with longer horizons (via comparing economic impacts for different rollover risk horizons). Moreover, we continue

to find stronger reduction in credit supply by foreign-funding-reliant banks with more pessimistic expectations.

The reason why we focus on banks' *long-term* cross-border debt prescheduled to mature at or shortly after the shock is to have a better causal measure. [Almeida et al. \(2012\)](#) proposes this identification strategy to identify the role of debt rollover risks on firm investment in the US after 2008. In our case, it could be that weaker banks may choose (or may be forced to choose) lower maturity on their foreign funding. Our choice of maturing long-term debt mitigates this potential endogeneity.

Alternatively, we now explore whether foreign wholesale loans -regardless of whether originated long before or in the run up to the sudden stop– scheduled to mature at or shortly after the sudden stop has a bearing on bank credit supply (Table 10). Consistent with the previously reported results, column (1) shows that banks with maturing foreign wholesale debt after the sudden stop reduce their supply of credit significantly and more strongly. Columns (2) and (3) focus on the extensive margins of credit supply, using this very alternative definition for bank rollover risk. Column (2) shows that banks with higher rollover risks are less likely to start a new lending relationship with a firm. Interestingly, banks with higher rollover risks (based on the alternative definition) are less likely to terminate an existing relationship with a firm (column (3)).

The impact of bank rollover risk at the intensive margin is weaker under the alternative roll-over risk measure (3.3% compared to 10.6%). This may potentially suggest that banks with greater share of maturing foreign wholesale debt that originated *shortly before* the sudden stop face relatively positive credit demand during the sudden stop (in other words, short-term borrowing banks from abroad may tend to work more with healthier firms in the run up to the sudden stop), or that these banks are better positioned in terms of capital or liquidity. In this regard, we compare the correlation between bank rollover risks (based on baseline vs. the alternatively defined) and loan portfolio and bank characteristics. We find that banks with greater share of maturing foreign wholesale debt that originated shortly before the sudden stop tend to work more with more indebted yet larger and exporter firms, and less with firms with a loan default history (Table 11). Moreover, such banks on average appear well-capitalized or more liquid. These cross-correlations, in essence, underlines that our baseline measure of rollover risk offer a better balancedness.

3.4.4. Does The Reduction in Credit Supply Differ Across Different Firms?

There has been much evidence that larger firms in general experience milder reduction in credit supply by more 'exposed' banks after an unfavorable liquidity shock (see, e.g., [Khwaja and Mian, 2008](#); [Iyer et al., 2014](#)). Our findings further uncover that it is not only the degree of banks' ex-ante

reliance on a certain liquidity source that suddenly dries up, but also banks' finding or expecting it difficult to rollover that matter for the heterogeneity of bank credit supply across firms (Table 12). Foreign-funding-reliant banks with higher rollover risks or more pessimistic expectations reduce their supply of credit mildly for larger, less short-term indebted or exporter firms. Moreover, we find similar results for the extensive margins of credit supply (Table 13).

4. Real Effects of the Sudden Stop

Note that the reduction in credit supply by more exposed banks may not pose a binding constraint on firms' overall financial needs. Considering alternative sources of funding, firms attached to these banks may borrow more from other firms, from its own partners/shareholders or increase its debt to employees, to ameliorate the potential effect of reduction in bank credit supply on real outcomes. Here, we show that such alternative sources of funding cannot fully offset the reduction in bank credit supply, eventually leading to adverse real effects (as also shown in the previous literature).

More importantly, we further show that credit supply shock to a firm (captured by the degree of working with banks that are ex-ante more exposed to the sudden stop) does not live and die within the firm, but rather, creates spillovers to the rest of firms within the economy through buyer-supplier linkages.

4.1. Direct Effects

Empirical Strategy. We first define a proxy for firm ex-ante exposure to the sudden stop due to the credit supply channel ($\Theta_{f,pre}$), where exposure depends on foreign funding, rollover risk, or expectations of banks that the firm is ex-ante working with. Formally, we define

$$\Theta_{f,pre} = \text{Reliance on Bank Credit}_{f,pre} * \sum_{b \in B^f} w_{bf,pre} * \mathcal{B}_{pre} \quad (2)$$

The first-term on the right-hand-side captures by how much the firm is dependent on bank credit, measured by $\frac{\text{Bank Credit}_{f,pre}}{\text{Bank Credit}_{f,pre} + \text{Trade Credit}_{f,pre}}$. The second term, $\sum_{b \in B} w_{bf,pre} * \mathcal{B}_{pre}$, is the weighted average ex-ante exposure to the sudden stop of banks the firm is working with prior to the sudden stop. $w_{bf,pre}$ is the share of credit granted by bank b to firm f in the firm's total bank credits, and \mathcal{B}_{pre} stand for bank foreign funding, or the interaction of bank foreign funding with rollover risk, or with FX Expectations. pre , as before, stands for prior to the sudden stop.

We then estimate the following model:

$$\Delta Y_{f,post} = \gamma \overbrace{\Theta_{f,pre}}^{\text{Firm ex-ante exposure to the sudden stop due to the credit supply channel}} + X_{f,pre} + \mu_{ic} + \varepsilon_{f,post} \quad (3)$$

where $\Delta Y_{f,post}$ is the change in the outcome variable for firm f from end-of-2008 to end-of-2009.²¹ The outcome variables are the sum of bank and trade credit, other debt (to shareholders or employees), total debt, operating profits, and tangible fixed assets (of firm f). To account for the fact that for some (but few) firms we observe zero values in some of these outcome variables before or after the sudden stop, we define $\Delta Y_{f,post}$ as $\frac{Y_{f,post} - Y_{f,pre}}{(1/2)(Y_{f,post} + Y_{f,pre})}$.

To make sure that the identified effects are due to the credit supply channel, we exploit variation across firms within the same industry *and* city (by including Industry (NACE 2-digit) \times city fixed effects, μ_{ic}). This essentially mitigates the concern that firms with higher $\Theta_{f,pre}$ may systematically be prone to the sudden stop via other potential channels (e.g., trade). Moreover, we control for a set of key firm variables, $X_{f,pre}$, namely, size (log(total assets)), inverse indebtedness (log(capital/total assets)), export ratio (overseas sales-to-total gross sales ratio), and short-term indebtedness (short-term debt-to-total debt ratio). We double cluster standard errors at the industry and city level.

Given this specification, our coefficient of interest, γ , gives us how firms that ex-ante work more with exposed banks differ in terms of change in the outcome variables, compared to firms within the same 2-digit sector and city.

Empirical Results. Table 14 presents the results. We focus on two sets of firms: The first set includes firms in our baseline regression, i.e., those at the intensive credit margin with multiple banking relationships. The second set includes firms that have a bank credit relationship prior to the shock, regardless of whether they work with a single bank or multiple banks or regardless of whether they continue or terminate their existing credit relationship after the shock.

The key finding is that firms that ex-ante work more with banks with higher ex-ante reliance on foreign funding cannot offset the reduction in bank credit by borrowing from other sources, such as firms or shareholders (columns (1) to (4)). Eventually, such firms had to deleverage (columns (5) and (6)), experience lower growth of operating profits (columns (7) and (8)), and reduce their investment more (columns (9) and (10)). Moreover, for the larger set of firms –which include single-bank firms and those they experienced terminated bank relationships as well–, we generally observe stronger effects. Lastly, the effects appear not only statistically significant but also economically of relevant

²¹ Since firm balance sheets and income statements are reported annually, we use end-of-the-year figures.

magnitude. For instance, more exposed firms had to deleverage by 2.5% to 4% (columns (5) and (6)), and reduce their fixed capital investment by 3.2% to 3.6% (columns (9) and (10)).

We do find similar results when we include bank rollover risks (Table 15). For firms that ex-ante work more with foreign-funding reliant banks with higher rollover risks, we observe binding financial constraints (columns (1), (3) and (5)), lower growth in operating profits (column (7)), and lower investment (column (9)). However, the marginal effect of working more with high rollover risk banks (on top of working with high foreign funding banks) seems negligible. We find similar results when we include bank expectations about future funding conditions (Table 16). Firms that ex-ante work more with foreign-funding-reliant banks with more pessimistic expectations experience binding financial constraints (columns (1), (3) and (5)), lower growth in operating profits (column (7)), and lower investment (column (9)), with the marginal effect of working more with pessimistic banks (on top of working more with high foreign funding banks) appearing negligible. In sum, the effect of working with ex-ante higher foreign funding banks seems to dominate rollover risk or expectations channels for real outcomes.

4.2. Indirect Effects

Empirical Strategy. Our final question studies whether firms that are *indirectly* exposed to the sudden stop through buyer-supplier linkages are also affected adversely. We first define firms' indirect exposure to the sudden stop ($\Theta_{f,pre}^{\text{indirect}}$) by taking into account by how much the firm is reliant on supplier purchases and weighted average of its suppliers' exposure to the sudden stop. In particular, we define

$$\Theta_{f,pre}^{\text{indirect}} = \frac{\text{Supplier Purchases}_{f,pre}}{\text{Cost of Sales}_{f,pre}} \sum_{s \in S^{f,pre}} w_{fs,pre} * \Theta_{s,pre} \quad (4)$$

where $s \in S^{f,pre}$ stands for the set of suppliers selling goods to the firm f prior to the shock, $w_{fs,pre}$ is the weight of each supplier s for firm f (the share of purchases from supplier s in total supplier purchases of firm f),²² and $\Theta_{s,pre}$ is the ex-ante exposure to the sudden stop (as defined in equation (2)) of supplier s . Accordingly, we augment equation (3) by including the indirect exposure measure, i.e., we estimate

²²For firms that do not work with a supplier, $\Theta_{f,pre}^{\text{indirect}}$ attains a value zero.

$$\Delta Y_{f,post} = \gamma_1 \underbrace{\Theta_{f,pre}}_{\text{Firm ex-ante exposure to the sudden stop due to the credit supply channel}} + \gamma_2 \underbrace{\Theta_{f,pre}^{\text{indirect}}}_{\text{Firm ex-ante indirect exposure to the sudden stop due to the credit supply channel}} + X_{f,pre} + \mu_{ic} + \varepsilon_{f,post} \quad (5)$$

where $\Theta_{f,pre}^{\text{indirect}}$ is as defined by equation (4), and other variables are as defined above. We measure whether firms that work more with exposed suppliers (i.e., with higher- $\Theta_{s,pre}$ suppliers, on average) experience more adverse real outcomes. Similar as above, the identified effect is among firms within the same industry and city, and we continue to control for key firm variables ($X_{f,pre}$).

Empirical Results. We find that firms more exposed to the sudden stop through its suppliers experience more adverse real consequences (Table 17). For financial outcomes or operating profits, we do not find significant effect of being indirectly exposed (columns (1) to (12)), while continuing to find significant effects for the direct effect. For investment, we find significant indirect real effects (columns (13) to (15)). In particular, a firm working more with exposed suppliers reduce its investment by 0.3% more –compared to a firm within the same industry and city, and with similar other observable characteristics, but working less with exposed suppliers–. The estimated coefficient for the indirect effect is about half of that for the direct effect (-0.658 vs. -0.378), and, evaluated at the respective interquartile ranges, it is close to one-tenth of the direct effect (0.3% vs. 3.5%).

4.3. Underlying Mechanism for Indirect Effects

A potential mechanism might be that suppliers that are ex-ante more exposed to the sudden stop –via working with banks with higher ex-ante reliance on foreign funding–, reduce their supply of inputs to their downstream firms.²³ To test whether this holds, we estimate the following equation:

$$\Delta S_{fs,post} = \eta \underbrace{\Theta_{s,pre}}_{\text{Supplier ex-ante exposure to the sudden stop due to the credit supply channel}} + X_{s,pre} + \mu_f + \varepsilon_{fs,post} \quad (6)$$

where $\Delta S_{fs,post}$ is the log change in total sales of supplier s to the buyer firm f from the period January 2008-September 2008 to the period January 2009-September 2009.²⁴ $\Theta_{s,pre}$ is the ex-ante

²³Previously, we show that the firm-level real effects of working more with banks with higher ex-ante reliance on foreign funding dominates working with high rollover risk or pessimistic banks. We therefore focus on bank foreign funding here.

²⁴Since firm-to-firm sales may or may not happen precisely in September 2008 or September 2009, we here take a longer time span for the ex-ante and ex-post periods, and to have equal time lengths for the *pre* and *post* periods and to avoid any potential seasonality, we take the two periods symmetric covering same months of the two years.

exposure of supplier s to the sudden stop, as defined in equation (2). μ_f stand for buyer firm fixed effects. We double cluster standard errors at buyer and seller firm level (thus account for potential correlation in errors for a given buyer, or for a given supplier).

We identify the effect by focusing on suppliers with different exposures to the sudden stop that supply to the same buyer firm. Later, we also include buyer \times supplier's industry \times supplier's city fixed effects to have coarsely similar suppliers or goods (with potentially similar transportations costs incurred) –at the expense of losing some observations due to limited number of buyers buying from at least two suppliers from the same industry and city. $X_{s,pre}$ stand for supplier firm characteristics (size, indebtedness, export ratio, and short-term indebtedness).

Note that equation (6) identifies downstream effects. To measure upstream effects, we augment equation (6) by substituting supplier's exposure to the sudden stop with the buyer's, and saturating the model with supplier fixed effects. By doing so, we essentially focus on buyers with different ex-ante exposures to the sudden stop that buy goods from a given supplier.

Contrasting our granular approach to identifying the mechanism with [Alfaro et al. \(2019\)](#), note that they have exploited firm-level balance sheet data and study whether including firm-level change in accounts payable in their baseline regressions soaks up the effect of downstream effects (where they gauge firm-to-firm linkages based on industry-level input-output tables). Here, we instead take a granular approach. We focus on suppliers working with the same buyer (or buyers working with the same supplier), and measure whether being more exposed to the sudden stop entails lower supply of goods by suppliers, or lower demand by buyers.

We show that exposed suppliers reduce their supply of goods to their downstream firms (Table 18). We start with a simple specification that includes suppliers' exposure to the sudden stop (weighted average ex-ante foreign funding of banks that the supplier was working with prior to the sudden stop), without further controls or fixed effects. We then saturate the model with buyer fixed effects for identification (column (2)), and buyer \times supplier's industry (NACE2) \times supplier's city fixed effects (column (3)). The identified coefficient in column (2) shows by how much a supplier that is ex-ante working more with high foreign funding banks prior to the sudden stop change its supply of goods to a given buyer (among suppliers that sell inputs to the same buyer). Column (3) restricts the set of suppliers to the same industry and city, that is, for a given buyer, we focus on suppliers that operate in the same industry and city –thus are more likely to supply similar goods with similar physical distances to the buyer firm–, yet differ in their exposures to the sudden stop.

Columns (2) to (4) show that, for a given buyer, the supplier that is ex-ante working more with

high foreign funding banks prior to the sudden stop reduce its supply of goods more in the aftermath of the shock. Economically, the effect appear relevant: Exposed suppliers reduce their sales more by 1.7% (column (2)) to 2.4% (column (4)).

Moreover, there exist upstream effects (columns (5) and (6)). For a given supplier, buyers that ex-ante work more with banks with higher ex-ante foreign funding reduce their demand. The effect is economically weaker than downstream effects (about one-tenth). In columns (7) and (8), we include supplier- and buyer-level control variables, and our key results remain intact.

Further Insights (Supplier Market Concentration). Intuitively, if a buyer firm has a more concentrated supplier market (i.e., if the majority of inputs to the buyer are provided by only a few suppliers), then the buyer might have a lower bargaining power (potentially leading to adverse price effects, see, e.g., [Kikkawa et al. \(2019\)](#)). Moreover, a firm relying on only a few suppliers may be less able to compensate the reduction in the supply of inputs by switching to less affected suppliers ([Huneus \(2018\)](#)). Along these lines, we interact firm indirect exposure to the sudden stop with ex-ante supplier market concentration. We calculate market concentration by Herfindahl-Hirschman index, formally as

$$C_{f,pre} = \sqrt{\sum_{s=1}^{Sf,pre} \left(\frac{\text{Purchased Value}_{f,s,pre}}{\text{Supplier Purchases}_{f,pre}} \right)^2} \quad (7)$$

where Purchased Value_{f,s,pre} is the total sales of supplier *s* to the buyer firm *f* during the pre period (January 2008–September 2008), and $C_{f,pre}$ is the Herfindahl-Hirschman concentration index. In the data, $C_{f,pre}$ ranges between 0.09 and 0.99 with an average of 0.652 (see [Table 3](#)).

We find that a buyer with a more concentrated supplier market prior to the sudden stop experiences a stronger drop in “other debt” (column (2)) and a stronger reduction in investment (column (5)) after the sudden stop –as given by the estimated negative and significant coefficient for the interaction of firm indirect exposure with supplier market concentration ([Table 19](#))–. Evaluated at the 3rd quartile of the distribution of supplier market concentration, firms that are indirectly exposed to the sudden stop reduce their investment by 0.79% more, close to one-fourth of the direct effect, and nearly twice as large for an otherwise-similar firm at the 1st quartile of the distribution of supplier market concentration (column (5)).

Moreover, having a concentrated supplier market *per se* has strong and adverse real effects (second row). In particular, evaluated at the mean indirect exposure, a firm at the 75th percentile of the distribution of supplier market concentration reduce its total debt by 7.2%, experiences 7.6%

reduction in operating profits, and reduces its fixed capital investment by 4.1%, compared to an otherwise-similar firm at the 25th percentile of the respective distribution.

5. Conclusion

We trace in a well-identified way how a sudden stop permeates through the economy via the credit supply channel, by exploiting the sudden stop of capital flows to Turkey after the Lehman collapse. We use several large-scale administrative databases crucial for identification, including the universes of interbank and bank-firm credit registers, foreign exchange rate expectations of banks, and domestic firm-to-firm sales.

We first show that it is not only banks' ex-ante reliance on global funding that suddenly dries up (as often documented in the literature), but also banks' having higher rollover risks in international wholesale markets and holding more pessimistic expectations about future funding conditions that drive the reduction in bank credit supply during the sudden stop. Second, the reduction in bank credit supply has direct and indirect real effects –which we show by using the universe of firm-to-firm sales data matched with the universe of bank-firm loans via the credit register–: exposed suppliers –that ex-ante work more with global-liquidity-reliant banks– reduce their *supply* of goods to their downstream firms more, and firms ex-ante working more with exposed suppliers reduce their investment more after the sudden stop (and more acutely so, for buyers with more concentrated supplier markets).

A follow-up analysis would be to broadly assess how a sudden stop propagates within the economy via channels other than the credit supply. For instance, firms with higher net open foreign currency positions are likely to be affected more adversely after a sudden stop, and these adverse effects potentially spill over to the firms in their production networks. We leave this for future work.

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TABLE 1: A BRIEF LIST OF PAPERS ON THE INTERNATIONAL TRANSMISSION OF FINANCIAL SHOCKS

Authors and Year*	Title	Shock Source → Destination	Level of Data**	# Observations***	Publication Details
Peek and Rosengren (1997)	The International Transmission of Financial Shocks: The Case of Japan	Decline in Japanese stock values → US	Bank Level	370	<i>American Economic Review</i> 87(4), pp.495-505.
Schnabl (2012)	International Transmission of Bank Liquidity Shocks: Evidence from an Emerging Market	1998 Russian default → Peru	Bank-Bank Bank-Firm	430 31,342	<i>Journal of Finance</i> 67, pp.897-932.
Cetorelli and Goldberg (2012a)	Liquidity management of U.S. global banks: Internal capital markets in the great recession	Global financial crisis → US global banks' intra-bank flows	Bank-Bank Affiliate	509	<i>Journal of International Economics</i> 88, pp.299-311.
Cetorelli and Goldberg (2012b)	Banking Globalization and Monetary Transmission	US monetary policy → US global banks' activating their internal capital markets	Bank-Bank Affiliate	43,921	<i>Journal of Finance</i> 67(5), pp.1811-1843.
Iyer, Peydro, da Rocha-Lopes, Schoar (2014)	Interbank Liquidity Crunch and the Firm Credit Crunch: Evidence from the 2007-2009 Crisis	Unexpected freeze of the European interbank market → Portugal	Bank-Firm	293,896	<i>Review of Financial Studies</i> 27, pp.347-372.
Jimenez, Ongena, Peydro, Saurina (2012)	Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications	ECB monetary policy → Spain	Bank-Firm (with loan applications)	816,852	<i>American Economic Review</i> 102, pp.2301-2326.
Ioannidou, Ongena, Peydro (2015)	Monetary Policy, Risk Taking, and Pricing: Evidence from a Quasi-Natural Experiment	US monetary policy → Bolivia	Bank-Firm	31,811	<i>Review of Finance</i> 19(1), pp.95-144.
Ongena, Peydro, van Horen (2015)	Shocks Abroad, Pain at Home? Bank-Firm Level Evidence on the International Transmission of Financial Shocks	Lehman collapse → Eastern Europe and Turkey	Bank Firm	256 37,500	<i>IMF Economic Review</i> 63(4), pp.698-750.
Cingano, Manaresi, Sette (2016)	Does Credit Crunch Investment Down? New Evidence on the Real Effects of the Bank-Lending Channel	Unexpected freeze of the European interbank market → Italy	Bank-Firm	151,690	<i>Review of Financial Studies</i> 29(10), pp.2737-2773.
di Giovanni, Kalemli-Özcan, Ulu, Başkaya (2018)	International Spillovers and Local Credit Cycles	Global risk aversion (VIX) → Turkey	Bank-Firm-Loan	19,982,267	<i>NBER Working Paper</i> No.23149.
Temesvary, Ongena, Owen (2018)	A Global Lending Channel Unplugged: Does U.S. Monetary Policy Affect Cross-border and Affiliate Lending by Global U.S. Banks?	US monetary policy → US global banks' cross-border lending	Bank-Country-Sector	60,840	<i>Journal of International Economics</i> 112(C), pp.50-69.
Buch, Bussiere, Goldberg, Hills (2019)	The international transmission of monetary policy	US, EU, UK, Japan monetary policy → 17 individual countries	Bank-Firm	--	<i>Journal of International Money and Finance</i> 91, 29-48.
Fendoglu, Gulsen, Peydro (2019)	Global Liquidity and the Impairment of Local Monetary Policy Transmission	Global liquidity conditions → Monetary policy transmission in Turkey	Bank-Firm-Loan	5,021,945	<i>CBRT Working Paper</i> No.1913.
Morais, Peydro, Roldan-Pena, Ruiz-Ortega (2019)	The International Bank Lending Channel of Monetary Policy Rates and Quantitative Easing: Credit Supply, Reach-for-yield, and Real Effects	US, EU, UK monetary policy → Mexico	Bank-Firm-Loan	8,268,794	<i>Journal of Finance</i> 74(1), pp.55-90.
Ongena, Schindele, Vonnak (2019)	In Lands of Foreign Currency Credit, Bank Lending Channels Run Through?	Foreign vs. domestic monetary policy → Hungary	Bank-Firm-Currency Type	2,385,314	<i>CFS Working Paper</i> No.474.

* The papers are ordered from oldest to newest (based on publication date).

** The most disaggregated data used in the study.

*** Number of observations in the baseline or the most saturated regression specification in the paper (whichever is higher).

TABLE 2: PERSISTENCE OF BANK FX EXPECTATIONS

	(1)	(2)	(3)
FX Expectations _{b,t-1}	0.481*** (0.046)	0.432*** (0.048)	0.437*** (0.048)
Median FX Expectations _t			0.057* (0.033)
Capital Adequacy Ratio _{b,t-1}		0.008 (0.015)	0.005 (0.015)
Liquidity Ratio _{b,t-1}		0.008 (0.011)	0.007 (0.011)
Log(Assets) _{b,t-1}		0.003** (0.001)	0.003* (0.001)
ROA _{b,t-1}		0.321** (0.133)	0.398*** (0.140)
NPL Ratio _{b,t-1}		0.157 (0.165)	0.141 (0.165)
Foreign Funding Ratio _{b,t-1}		0.004 (0.011)	0.004 (0.011)
Observations	380	374	374
R-squared	0.224	0.251	0.257

Note: The dependent variable is bank FX Expectations (12-month-ahead expected change in the USD/TRY exchange rate). The sample period is January 2007-September 2009. All bank controls are one month lagged. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 3: SUMMARY STATISTICS

Variables	Definition	Mean	Median	SD	25%	75%	N
CREDIT SUPPLY CHANNEL ANALYSES							
<u>Dependent Variables</u>							
Change in Credit	Log change in the credit limit of bank <i>b</i> to firm <i>f</i> currency type <i>c</i>	-0.226	-0.051	1.142	-0.4	0.034	292,717
New Lending	=1 if a bank establishes a new lending relationship with a firm that it was not working with prior to sudden stop; 0 otherwise	0.15	0	0.357	0	0	478,919
Termination	=1 if a bank terminates an existing relationship with a firm after the sudden stop; 0 otherwise	0.206	0	0.405	0	0	383,872
<u>Independent Variables</u>							
Bank-Level Variables							
Foreign Funding	Non-core foreign currency (FX) liabilities to total assets ratio	0.113	0.112	0.045	0.107	0.129	292,717
Rollover Risk	The ratio of long-term (>1 year) foreign-currency denominated cross-border wholesale loans that matures at 2008m10 to 2009m5 to total foreign-currency denominated cross-border wholesale loans (in %)	12.223	15.462	8.399	0.99	16.301	292,717
Rollover Risk (alternative definition)	Similar as above, except that we take both long-term and short-term foreign-currency cross-border wholesale funding	44.32	45.48	17.87	29.04	54.89	292,717
FX Expectations	Expected depreciation (log-difference between 12-m-ahead USD/TRY exchange rate and actual rate, measured at September 2008). Defined as such, higher positive values mean greater expected domestic currency depreciation.	7.083	7.41	3.032	6.811	8.153	292,717
Capital Adequacy Ratio	Tier-1 Capital to Total Risk-Weighted Assets	0.162	0.163	0.028	0.154	0.165	292,717
Liquidity Ratio	Liquid assets (cash + receivables from the central bank + interbank money market + reverse repo receivables) to total assets	0.296	0.303	0.1	0.189	0.385	292,717
Size	Natural logarithm of total assets	17.788	18.185	0.862	17.729	18.229	292,717
ROA	Pre-tax net profit to total assets	2.005	2.179	0.391	1.763	2.224	292,717
NPL Ratio	The ratio of non-performing loans (with an overdue past 90 days) to total credit	0.575	0.528	0.513	0	0.992	292,717
Bank-Firm Level Variables							
Strength of Bank-Firm Relationship	Share of loan amount from bank <i>b</i> to firm <i>f</i> in firm <i>f</i> 's total bank loans in September 2008	0.315	0.232	0.276	0.084	0.492	292,717
Number of banking relationship per firm	Number of banks a firm is working with prior to sudden stop	3.619	3	1.756	2	4	292,717
Firm-Level Variables							
Firm Log(Assets)	Log of firm total assets	13.344	13.242	1.669	12.268	14.31	234,957
Firm Log(Capital/Assets)	Log of firm capital-to-assets ratio	-1.962	-1.773	1.559	-2.843	-0.908	234,957
Firm Export/Sales	The ratio of exports (overseas sales) to total gross sales	0.054	0	0.191	0	0	234,957
Firm STDebt / Debt	The ratio of short-term total liabilities-to-total liabilities	0.883	1	0.245	0.923	1	234,957

(continues on the next page)

TABLE 3: SUMMARY STATISTICS (CONTINUED)

Variables	Definition	Mean	Median	SD	25%	75%	N
REAL EFFECT ANALYSES (Firm Level)							
<u>Dependent Variables</u>							
Change in Bank and Trade Credit	Δ total bank+trade credit, where Δ is $(Y_{post-Y_{pre}})/(1/2*(Y_{post+Y_{pre}}))$	-0.036	0	0.916	-0.457	0.401	234,957
Change in Other Debt	Δ other debt (sum of payables to shareholders, affiliates, and personnel)	0.106	0	1.142	-0.222	0.638	234,956
Change in Total Debt	Δ sum of bank credit, trade credit and other debt	-0.01	0	0.806	-0.347	0.365	234,957
Change in Operating Profits	Δ operating profits	-0.04	-0.029	4.019	-0.87	0.682	234,776
Change in Tangible Fixed Assets	Δ tangible fixed assets	-0.004	0	0.62	-0.18	0.137	234,957
<u>Independent Variables</u>							
Firm Ex-ante Exposure to the Sudden Stop (based on bank foreign funding)	Weighted average Sep-2008 level of "Foreign Funding" of banks that the firm is working with, with the weights based on the share of the bank for the firm's total bank credits, multiplied by Bank Credits / (Bank Credits + Trade Credits)	0.031	0.006	0.042	0	0.054	234,957
Firm Ex-ante Exposure to the Sudden Stop (based on bank foreign funding*rollover risk)	Similar as above, except that we take "Foreign Funding*Rollover Risk" of banks	0.438	0.029	0.704	0	0.638	234,957
Firm Ex-ante Exposure to the Sudden Stop (based on bank foreign funding*FX Expectations)	Similar as above, except that we take "Foreign Funding*FX Expectations" of banks	0.236	0.031	0.35	0	0.373	234,957
REAL NETWORK EFFECT ANALYSES (Firm or Firm-to-Firm Level)							
<u>Dependent Variable</u>							
Change in Firm-to-Firm Sales	Log change in firm-to-firm sales	-0.169	-0.108	1.135	-0.77	0.436	985,054
<u>Independent Variables</u>							
Suppliers' Ex-ante Exposure to the Sudden Stop	Firm Ex-ante Exposure to the Sudden Stop (as defined above) of supplier firms	0.093	0.111	0.062	0.069	0.126	985,054
Buyers' Ex-ante Exposure to the Sudden Stop	Firm Ex-ante Exposure to the Sudden Stop (as defined above) of buyer firms	0.117	0.113	0.039	0.106	0.129	985,054
Supplier Market Concentration	Herfindahl-Hirschman Market Concentration in supplier purchases	0.652	0.665	0.186	0.516	0.787	103,901
Firm Ex-ante Indirect Exposure to the Sudden Stop (based on bank foreign funding)	Weighted average "Ex-ante Exposure to the Sudden Stop" of the suppliers the firm is working with, multiplied by Total Supplier Purchases/Total Cost of Sales, where the exposure is based on bank foreign funding	0.005	0.003	0.008	0	0.007	234,957
Firm Ex-ante Indirect Exposure to the Sudden Stop (based on bank foreign funding*rollover risk)	Similar as above, except that we take "Foreign Funding*Rollover Risk" of banks	0.072	0.036	0.12	0	0.094	234,957
Firm Ex-ante Indirect Exposure to the Sudden Stop (based on bank foreign funding*FX Expectations)	Similar as above, except that we take "Foreign Funding*FX Expectations" of banks	0.039	0.021	0.062	0	0.053	234,957

(end of the Table)

TABLE 4: BASELINE RESULTS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Foreign Funding	-0.755*** (0.036)	-1.051*** (0.053)	-2.597*** (0.103)	-3.494*** (0.154)	-2.445*** (0.098)	-6.014*** (0.205)	-5.938*** (0.210)	-6.715*** (0.217)	-6.367*** (0.232)
Foreign Funding * Rollover Risk			-0.150*** (0.010)	-0.271*** (0.012)		-0.314*** (0.013)	-0.452*** (0.019)	-0.364*** (0.014)	-0.458*** (0.019)
Foreign Funding * FX Expectations					-0.890*** (0.049)	-1.248*** (0.063)	-5.309*** (0.200)	-1.418*** (0.070)	-4.716*** (0.191)
Foreign Funding * Rollover Risk * FX Expectations							-0.458*** (0.024)		-0.386*** (0.023)
Bank Controls	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Strength of the Bank-Firm Relationship	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	Yes	Yes	Yes	Yes	Yes	--	--
Currency-type FE	No	Yes	Yes	Yes	Yes	Yes	Yes	--	--
Firm x Currency-type FE	No	No	No	No	No	No	No	Yes	Yes
Observations	460,080	292,717	292,717	292,717	292,717	292,717	292,717	281,960	281,960
R-squared	0.001	0.383	0.384	0.391	0.392	0.394	0.396	0.426	0.427

Economic Impacts

Log-change in credit granted (in % terms)
... by high foreign funding bank (p75-p25)

-1.7 **-2.3** **-5.7** **-7.7** **-5.4** **-13.2** **-13.1** **-14.8** **-14.0**

For a high foreign funding bank
... if high rollover risk (p75-p25)
... if pessimistic (p75-p25)

-5.1 **-9.1** **--** **--** **-2.6** **-10.6** **-15.2** **-12.3** **-15.4**

-- **--** **--** **--** **-2.6** **-3.7** **-15.7** **-4.2** **-13.9**

-20.7 **-17.4**

For a high foreign funding, high rollover risk & pessimistic bank

Note 1: The dependent variable is the log change in credit granted by bank b to firm f in currency-type c. "Foreign Funding" is the ratio of bank non-core foreign-currency liabilities to total assets. "Rollover Risk" is defined as the ratio of long-term (>1 year) foreign wholesale funding that is going to mature shortly after the sudden stop (in any month during October 2008-May 2009) to total foreign wholesale funding. "FX Expectations" is the log-difference between expected 12-month-ahead USD/TRY exchange rate and the current rate. Thus defined, banks with higher values for "FX Expectations" ex-ante expect a less valued domestic currency over the following 12 months. Bank controls are bank capital adequacy ratio, liquidity ratio, log of asset size, return-on-assets (ROA), and the ratio of non-performing loans-to-total loans (NPL). In column (3) and onwards where we start including bank controls, we also include the strength of the bank-firm relationship (the ratio of credit extended by a bank to a firm to total bank credit extended to the firm). All bank variables and the strength of the bank-firm relationship are measured ex-ante (September 2008). In columns (2) and onwards, we focus on firms with at least two banking relationships. All bank variables are de-meant. Moreover, variables that appear in an interaction term are included in levels as well. "Yes" indicates that corresponding variables or fixed effects are included. "No" indicates that corresponding variables or fixed effects are not included. "--" indicates that corresponding fixed effects are already absorbed by other set of fixed effects (hence not applicable). Standard errors are clustered at the firm level, and given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

Note 2: Economic impacts are calculated by multiplying the estimated corresponding coefficient with the interquartile range of the respective variables. For example, we observe in lower panel of column (3) that banks with higher foreign funding and higher rollover risk reduce their supply of credit by 5.1% (log approximated). We use total differentiation to reach -5.1, i.e., we multiply -0.150, the estimated corresponding coefficient, with the interquartile range of foreign funding (which is 0.022) and with the interquartile range of rollover risk (which is 15.31), and finally with 100 to have the resulting number in percentage terms. We follow the same procedure in all columns and subsequent tables where we report economic impacts.

TABLE 5: DIFFERENT LEVELS OF AGGREGATION AND BINDING REDUCTION IN BANK CREDIT SUPPLY

Level of Aggregation:	Panel (A)			Panel (B)		
	Bank-Firm Level			Firm-Level		
	(1)	(2)	(3)	(4)	(5)	(6)
Foreign Funding	-0.750*** (0.054)	-1.151*** (0.064)	-6.076*** (0.200)	-6.464*** (0.225)	-0.445*** (0.086)	7.790*** (0.430)
Foreign Funding * Rollover Risk			-0.304*** (0.012)	-0.290*** (0.014)		-0.267*** (0.019)
Foreign Funding * FX Expectations			-0.747*** (0.042)	-0.661*** (0.052)		-1.510*** (0.073)
Bank Controls and the Strength of the Bank-Firm Relationship	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes	--	--
Observations	277,231	277,231	277,231	277,231	102,577	102,577
R-squared	0.011	0.423	0.017	0.428	0.006	0.013
<i>Economic Impacts</i>						
Log-change in credit granted (in % terms)						
... by high foreign funding bank (p75-p25)	-1.7	-2.5	-13.4	-14.2	-1.281	--
For a high foreign funding bank					--	-0.263
... if high rollover risk (p75-p25)			-10.2	-9.8	--	-1.498
... if pessimistic (p75-p25)			-2.2	-2.0	--	

Notes: The dependent variable is the log change in credit granted by bank *b* to firm *f* (columns 1 to 4), or the log change in total bank credit granted to firm *f* (columns 5 and 6). Foreign-currency credits are adjusted for exchange rate changes before aggregating at the bank-firm- or firm-level (for details on exchange rate adjustment, see text). "W.Aveg. Foreign Funding" in column (5) and (6) stands for the average foreign funding ratio of banks that the firm *f* is working with in September 2008, weighted by the share of bank *b* credits in total bank credit for firm *f* (similarly, the interaction terms "Foreign Funding * Rollover Risk" and "Foreign Funding * FX Expectations" as well as all bank controls are averaged at the firm-level with the same weighting). The levels of W.Aveg. Rollover Ratio and W.Aveg. FX Expectations are also included in columns (5) and (6). As before, all right-hand-side variables are measured ex-ante. "Yes" indicates that corresponding variables or fixed effects are included. "No" indicates that corresponding fixed effects are not included. "--" indicates that the corresponding set of fixed effects is not applicable. Standard errors, given in parentheses, are clustered at the firm level in columns (1) to (4). *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 6: BANK ROLLOVER RISKS AND FX EXPECTATIONS VS. CHARACTERISTICS OF FIRMS IN THEIR LOAN PORTFOLIOS

Cross-Correlations	Foreign Funding	Rollover Risk	FX Expectations
W. Aveg. Firm Log(Total Assets)	0.504*	0.104	-0.464*
W. Aveg. Firm Log(Capital/Assets)	-0.179	-0.181	0.353
W. Aveg. Firm Export/Sales	0.098	-0.25	-0.163
W. Aveg. Firm Short-term Debt / Total Debt	-0.209	-0.025	-0.485*
W. Aveg. Firm Past Loan Default	-0.391	0.07	-0.003
W. Aveg. Firm Future Loan Default	-0.356	0.011	-0.077

Notes. Each entry corresponds to pair-wise correlations. For instance, W. Aveg. Firm Log(Total Assets) is the average log(total assets) of firms that exist in a bank's loan portfolio in September 2008, weighted by the share of a firm in total credit granted by the bank. We followed the same procedure for the remaining variables. Firm Past Loan Default is a dummy variable that takes a value 1 if the firm has defaulted on at least one loan at a bank during the last 2 years before the sudden stop, and 0 otherwise. Firm Future Loan Default is a dummy variable that takes a value 1 if the firm has defaulted on at least one loan at a bank during the following 2 years after the sudden stop, and 0 otherwise. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 7: BANK ROLLOVER RISKS AND FX EXPECTATIONS VS. BANK CHARACTERISTICS

Cross-Correlations	Foreign Funding	Rollover Risk	FX Expectations	Capital Adequacy Ratio	Liquidity Ratio	Log(Assets)	Return on Assets	NPL Ratio
Foreign Funding	1.000							
Rollover Risk	-0.102	1.000						
FX Expectations	-0.248	0.439	1.000					
Capital Adequacy Ratio	0.061	-0.287	0.067	1.000				
Liquidity Ratio	-0.036	-0.135	0.106	0.716***	1.000			
Log(Assets)	-0.513*	0.448*	0.348	-0.352	-0.137	1.000		
Return on Assets	-0.111	-0.126	0.199	0.645**	0.234	-0.185	1.000	
NPL Ratio	0.316	-0.057	-0.289	-0.172	-0.325	-0.361	-0.077	1.000

Notes: Each entry corresponds to pair-wise correlations. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 8: EXTENSIVE MARGIN

	New Lending			Dependent Variable:				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Foreign Funding	-0.788 ^{***} (0.014)	-0.694 ^{***} (0.029)	-1.011 ^{***} (0.022)	-1.399 ^{***} (0.036)	0.068 ^{***} (0.017)	0.482 ^{***} (0.047)	0.354 ^{***} (0.030)	1.165 ^{***} (0.055)
Foreign Funding * Rollover Ratio		-0.003 (0.003)		-0.025 ^{***} (0.003)		0.005 (0.004)		0.028 ^{***} (0.004)
Foreign Funding * FX Expectations			-0.281 ^{***} (0.009)	-0.358 ^{***} (0.011)			0.187 ^{***} (0.013)	0.389 ^{***} (0.014)
Bank Controls	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Strength of the Bank-Firm Relationship	--	--	--	--	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	478,296	478,296	478,296	478,296	383,460	383,460	383,460	383,460
R-squared	0.399	0.412	0.414	0.414	0.398	0.416	0.415	0.417

Economic Impacts

Prob. of New Lending/Termination (in % terms)

... by high foreign funding bank (p75-p25)

For a high foreign funding bank

... if high rollover risk (p75-p25)

... if pessimistic (p75-p25)

	-1.7	-1.5	-2.2	-3.1	0.1	1.1	0.8	2.6
		-0.1	--	-0.8		0.2	--	0.9
		--	-0.8	-1.1		--	0.6	1.1

Notes: "New Lending" is an indicator variable that takes a value 1 if the bank establishes a new lending relationship with a firm that the bank was not working with in September 2008; and 0 otherwise. "Termination" is an indicator variable that takes a value 1 if a bank terminates its existing relationship with a firm in the aftermath of the shock (in September 2009); and 0 otherwise. "Yes" indicates that corresponding variables or fixed effects are included. "No" indicates that corresponding fixed effects are not included. Standard errors are clustered at the firm level, and are given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 9: ROBUSTNESS: ROLLOVER RISKS BASED ON DIFFERENT HORIZONS

	Rollover Risk									
	The ratio of long-term foreign wholesale funding debt maturing within k months after the shock									
k :	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Foreign Funding	-2.090 ^{***} (0.180)	-6.545 ^{***} (0.393)	-1.306 ^{***} (0.141)	-3.182 ^{***} (0.245)	-1.228 ^{***} (0.145)	-2.819 ^{***} (0.251)	-3.219 ^{***} (0.153)	-5.800 ^{***} (0.213)	-3.494 ^{***} (0.154)	-6.014 ^{***} (0.205)
Foreign Funding * Rollover Risk	-0.257 ^{***} (0.017)	-0.458 ^{***} (0.031)	-0.189 ^{***} (0.013)	-0.186 ^{***} (0.018)	-0.188 ^{***} (0.013)	-0.163 ^{***} (0.018)	-0.262 ^{***} (0.012)	-0.309 ^{***} (0.014)	-0.271 ^{***} (0.012)	-0.314 ^{***} (0.013)
Foreign Funding * FX Expectations	-1.208 ^{***} (0.089)		-0.728 ^{***} (0.072)		-0.634 ^{***} (0.073)		-1.217 ^{***} (0.064)		-1.248 ^{***} (0.063)	
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Currency-type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	292,717	292,717	292,717	292,717	292,717	292,717	292,717	292,717	292,717	292,717
R-squared	0.391	0.395	0.391	0.393	0.391	0.394	0.391	0.394	0.391	0.394
<i>Economic Impacts</i>										
Log-change in credit granted (in % terms)										
... by high foreign funding bank (p75-p25)	-4.6	-14.4	-2.9	-7.0	-2.7	-6.2	-7.1	-12.8	-7.7	-13.2
For a high foreign funding bank										
... if high rollover risk (p75-p25)	-8.7	-15.4	-6.4	-6.3	-6.3	-5.5	-8.8	-10.4	-9.1	-10.6
... if pessimistic (p75-p25)	--	-3.6	--	-2.1	--	-1.9	--	-3.6	--	-3.7

Notes: The dependent variable is the log change in credit granted by bank b to firm f in currency-type c . Rollover Risk for $k=4$ months stands for the ratio of long-term foreign wholesale funding debt that is going to mature within 4 months after the shock (October 2008-January 2009) to total foreign wholesale funding. Similarly defined for alternative k s. $k=8$ is the baseline specification. The levels of interacted variables are included in all columns. "Yes" indicates that corresponding variables or fixed effects are included. Standard errors are clustered at firm level, and given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 10: ROBUSTNESS: ROLLOVER RISK BASED ON AN ALTERNATIVE DEFINITION

	Intensive Margin	New Lending Margin	Termination Margin
	(1)	(2)	(3)
Foreign Funding	-4.714*** (0.158)	-1.357*** (0.026)	0.029 (0.040)
Foreign Funding * Rollover Risk (alternative definition)	-0.058*** (0.004)	-0.006*** (0.001)	-0.016*** (0.001)
Foreign Funding * FX Expectations	-1.185*** (0.043)	-0.434*** (0.009)	0.169*** (0.013)
Bank Controls	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes
Currency-type FE	Yes	--	--
Observations	292,717	478,296	383,460
R-squared	0.395	0.420	0.416
<i>Economic Impacts</i>			
Log-change in credit granted (in % terms)			
... by high foreign funding bank (p75-p25)	-10.4	-3.0	0.1
For a high foreign funding bank			
... if high rollover risk (p75-p25)	-3.3	-0.3	-0.9
... if pessimistic (p75-p25)	-3.5	-1.3	0.5

Notes: The dependent variable is the log change in credit granted by bank b to firm f in currency-type c . Rollover Risk is the ratio of long-term *and* short-term foreign wholesale funding that is going to mature within 8 months after September 2008 to total foreign wholesale funding. The levels of interacted variables are included in all columns. "Yes" indicates that corresponding variables or fixed effects are included. Standard errors are clustered at firm level, and given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 11: ROLLOVER RISKS (BASELINE VS. ALTERNATIVE DEFINITION) VS. BANK LOAN PORTFOLIO CHARACTERISTICS

Cross-Correlations	Rollover Risk (Baseline: based on maturing long- term foreign wholesale debt)	Rollover Risk (based on maturing short- and long-term foreign wholesale debt)
W. Aveg. Firm Log(Total Assets)	0.104	0.366
W. Aveg. Firm Log(Capital/Assets)	-0.179	-0.446*
W. Aveg. Firm Export/Sales	-0.255	0.461*
W. Aveg. Firm Short-term Debt / Total Debt	-0.040	0.491*
W. Aveg. Firm Past Loan Default	-0.091	-0.284
W. Aveg. Firm Future Loan Default	0.060	0.089
Foreign Funding	-0.102	-0.094
Rollover Risk (Baseline)	1.000	0.022
FX Expectations	0.439	-0.122
Capital Adequacy Ratio	-0.287	0.369
Liquidity Ratio	-0.135	0.442
Log(Assets)	0.448*	-0.478*
Return on Assets	-0.126	0.228
NPL Ratio	-0.057	-0.099

Notes. Each entry corresponds to pair-wise correlations. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 12: FIRM CHARACTERISTICS VS. INTENSIVE MARGIN OF CREDIT SUPPLY

	Log(Total Assets)			Log(Capital/Total Assets)					Exports/Sales					Short-Term Debt / Total Debt		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Foreign Funding	-2.072*** (0.351)	-9.138*** (0.914)	-1.863*** (0.517)	-8.607*** (0.871)	-0.407*** (0.099)	-3.431*** (0.225)	-2.394*** (0.130)	-5.739*** (0.267)	-0.581*** (0.066)	-3.788*** (0.166)	-2.487*** (0.100)	-6.003*** (0.204)	-0.858*** (0.149)	-2.260*** (0.356)	-2.869*** (0.197)	-4.943*** (0.415)
Foreign Funding * Firm Variable	0.101*** (0.023)	0.349*** (0.059)	-0.023 (0.036)	0.159*** (0.060)	0.055 (0.036)	0.070 (0.075)	0.032 (0.040)	0.124 (0.080)	0.639*** (0.245)	1.747*** (0.443)	0.749** (0.300)	1.755*** (0.509)	0.435** (0.181)	-1.597*** (0.410)	0.581*** (0.214)	-1.419*** (0.442)
Foreign Funding * Rollover Risk	-0.662*** (0.086)		-0.780*** (0.088)		-0.268*** (0.020)		-0.308*** (0.021)		-0.295*** (0.013)		-0.318*** (0.014)		-0.133*** (0.035)		-0.169*** (0.037)	
Foreign Funding * Rollover Risk * Firm Variable	0.024*** (0.006)		0.028*** (0.006)		0.005 (0.007)		0.003 (0.008)		0.129*** (0.043)		0.110** (0.045)		-0.174*** (0.040)		-0.190*** (0.041)	
Foreign Funding * FX Expectations			-2.841*** (0.227)	-2.533*** (0.228)			-0.843*** (0.062)	-1.027*** (0.060)			-0.976*** (0.047)	-1.129*** (0.047)			-0.630*** (0.079)	-0.819*** (0.085)
Foreign Funding * FX Expectations * Firm Variable			0.116*** (0.014)	0.076*** (0.015)			0.028 (0.019)	0.078*** (0.022)			0.702*** (0.124)	0.671*** (0.146)			-0.412*** (0.099)	-0.704*** (0.114)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Strength of the Bank-Firm Relationship	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Currency-type FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	280,792	280,792	280,792	280,792	280,200	280,200	280,200	280,200	280,792	280,792	280,792	280,792	280,122	280,122	280,122	280,122
R-squared	0.387	0.389	0.390	0.392	0.387	0.389	0.389	0.392	0.387	0.389	0.390	0.392	0.387	0.389	0.390	0.392

Notes: The dependent variable is the log change in credit granted by bank *b* to firm *f* in currency-type *c*. Bank controls and the strength of the bank-firm relationship, measured ex-ante, are included in all columns. "Yes" indicates that corresponding variables or fixed effects are included. Standard errors are clustered at the firm level, and given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 13: FIRM CHARACTERISTICS VS. EXTENSIVE MARGINS OF CREDIT SUPPLY

Firm Variable	Dependent Variable:							
	New Lending			Termination				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(Total Assets)	log(Capital/Total Assets)	Exports/Sales	Short-Term Debt / Total Debt	Log(Total Assets)	log(Capital/Total Assets)	Exports/Sales	Short-Term Debt / Total Debt	
Foreign Funding	-3.511*** (0.197)	-0.695*** (0.037)	-0.929*** (0.026)	-0.383*** (0.070)	-0.856*** (0.213)	-0.005 (0.053)	-0.154*** (0.037)	-0.127 (0.096)
Foreign Funding * Firm Variable	0.191*** (0.013)	0.038** (0.016)	0.766*** (0.109)	-0.316*** (0.083)	0.109*** (0.014)	-0.082*** (0.023)	0.407*** (0.147)	0.993*** (0.116)
Foreign Funding * Rollover Risk	-0.284*** (0.020)	-0.000 (0.004)	-0.023*** (0.003)	-0.003 (0.008)	-0.245*** (0.024)	-0.015*** (0.006)	-0.027*** (0.004)	-0.044*** (0.011)
Foreign Funding * Rollover Risk * Firm Variable	0.016*** (0.001)	0.015*** (0.002)	0.043*** (0.012)	-0.042*** (0.010)	0.017*** (0.002)	-0.001 (0.002)	0.060*** (0.015)	0.059*** (0.013)
Foreign Funding * FX Expectations	-0.374*** (0.046)	-0.034*** (0.010)	-0.055*** (0.006)	-0.009 (0.017)	-0.362*** (0.055)	-0.008 (0.013)	-0.013 (0.009)	-0.028 (0.022)
Foreign Funding * FX Expectations * Firm Variable	0.024*** (0.003)	-0.012*** (0.005)	0.156*** (0.026)	0.022 (0.022)	0.012*** (0.003)	0.025*** (0.006)	0.109*** (0.035)	-0.161*** (0.028)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Strength of the Bank-Firm Relationship	--	--	--	--	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	455,300	454,089	455,300	453,766	365,920	364,951	365,920	364,795
R-squared	0.403	0.400	0.398	0.401	0.412	0.410	0.410	0.411

Notes: Dependent variables are "New Lending" for columns (1) to (4), and "Termination" for columns (5) to (8). "Yes" indicates that corresponding variables or fixed effects are included. Standard errors are clustered at the firm level, and given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 14: REAL EFFECTS: BASELINE

Set of Firms:	Intensive Margin (Multiple Banking Relationship)		Intensive Margin (Multiple Banking Relationship)		Intensive Margin (Multiple Banking Relationship)		Intensive Margin (Multiple Banking Relationship)		Intensive Margin (Multiple Banking Relationship)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Change in Outcome Variable:	Δ (Bank Credit + Trade Credit)		Δ Other Debt		Δ Total Debt		Δ Operating Profits		Δ Tangible Fixed Assets	
Firm Ex-ante Exposure to the Sudden Stop (based on Bank Foreign Funding)	-1.222*** (0.146)	-1.857*** (0.162)	0.614*** (0.103)	0.693*** (0.087)	-0.461*** (0.084)	-0.757*** (0.114)	-0.331 (0.381)	-0.337** (0.154)	-0.595*** (0.044)	-0.662*** (0.034)
Firm Log(Total Assets)	-0.014*** (0.002)	-0.017*** (0.003)	0.017** (0.007)	0.011** (0.005)	-0.021*** (0.002)	-0.028*** (0.003)	-0.005 (0.016)	-0.011 (0.008)	0.021*** (0.002)	0.012*** (0.002)
Firm Log(Capital/Total Assets)	0.029*** (0.004)	0.029*** (0.002)	0.023*** (0.005)	0.026*** (0.003)	0.034*** (0.003)	0.036*** (0.003)	-0.005 (0.009)	0.002 (0.007)	0.004** (0.002)	0.006*** (0.001)
Firm Exports/Sales	0.019 (0.017)	0.012 (0.016)	0.017 (0.026)	0.040 (0.030)	0.014 (0.018)	0.013 (0.021)	-0.148** (0.067)	-0.129*** (0.015)	-0.024 (0.016)	-0.002 (0.015)
Firm Short-term Debt/Total Debt	-0.089*** (0.011)	-0.115*** (0.009)	0.129*** (0.032)	0.118*** (0.018)	-0.001 (0.010)	-0.018* (0.010)	-0.016 (0.035)	-0.117*** (0.036)	0.009 (0.010)	0.001 (0.004)
Industry x City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	94,876	234,958	94,876	234,957	94,876	234,958	94,843	234,775	94,876	234,957
R-squared	0.039	0.028	0.028	0.018	0.040	0.030	0.024	0.014	0.031	0.021
<i>Economic Impacts</i>										
Change in the Outcome Variable for a firm that ex-ante and on average borrows more from banks with higher foreign funding ratio (p75-p25)	-6.6	-10.0	3.3	3.7	-2.5	-4.1	-1.78	-1.81	-3.2	-3.6

Notes: "Firm Ex-ante Exposure to the Sudden Stop" is defined as the weighted average foreign funding of banks that the firm was working with, multiplied by firm's dependency on bank credit, measured in September 2008. All columns include Industry (NACE2) x City fixed effects. Standard errors are clustered at the Industry and City level, and given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 15: REAL EFFECTS: THE ROLE OF BANK ROLLOVER RISKS

Change in Outcome Variable:	Firm Exposure to the Sudden Stop through ex-ante foreign funding of banks that the firm was working with prior to the sudden stop									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm Ex-Ante Exposure to the Sudden Stop (based on Bank Foreign Funding x Rollover Risk)	-0.100*** (0.007)	-0.017* (0.010)	0.034*** (0.004)	-0.008* (0.004)	-0.041*** (0.006)	-0.008 (0.008)	-0.006 (0.007)	0.048** (0.021)	-0.034*** (0.002)	0.003 (0.005)
Firm Ex-Ante Exposure to the Sudden Stop (based on Bank Foreign Funding)	-1.606*** (0.239)	-1.606*** (0.239)	0.806*** (0.110)	0.806*** (0.110)	0.806*** (0.110)	-0.638*** (0.158)	-1.047** (0.428)	-1.047** (0.428)	-0.699*** (0.094)	-0.699*** (0.094)
Firm Log(Total Assets)	-0.020*** (0.002)	-0.017*** (0.003)	0.012*** (0.005)	0.011** (0.005)	-0.029*** (0.003)	-0.028*** (0.003)	-0.012 (0.008)	-0.010 (0.008)	0.011*** (0.002)	0.013*** (0.002)
Firm Log(Capital/Total Assets)	0.028*** (0.002)	0.029*** (0.002)	0.027*** (0.003)	0.026*** (0.003)	0.035*** (0.003)	0.036*** (0.003)	0.002 (0.007)	0.003 (0.007)	0.006*** (0.001)	0.006*** (0.001)
Firm Exports/Sales	0.010 (0.016)	0.012 (0.016)	0.040 (0.029)	0.040 (0.030)	0.012 (0.021)	0.013 (0.021)	-0.129*** (0.015)	-0.128*** (0.016)	-0.003 (0.015)	-0.002 (0.015)
Firm Short-term Debt/Total Debt	-0.100*** (0.010)	-0.115*** (0.009)	0.111*** (0.018)	0.118*** (0.018)	-0.012 (0.010)	-0.018* (0.010)	-0.108*** (0.035)	-0.117*** (0.036)	0.007* (0.004)	0.001 (0.004)
Industry x City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234,958	234,958	234,957	234,957	234,958	234,958	234,775	234,775	234,957	234,957
R-squared	0.027	0.028	0.017	0.018	0.029	0.030	0.014	0.014	0.021	0.021
<i>Economic Impacts</i>										
Change in the Outcome Variable for a firm that ex-ante and on average borrows more from higher foreign funding banks with higher rollover risk (p75-p25)	-6.4	-1.1	2.2	-0.5	-2.6	-0.5	-0.4	3.1	-2.2	0.2
Change in the Outcome Variable for a firm that ex-ante and on average borrows more from higher foreign funding banks (p75-p25)	---	-8.6	---	4.3	---	-3.4	---	-5.6	---	-3.8

Notes: "Firm Exposure to the Sudden Stop" is defined as the weighted average foreign funding of banks that the firm is working with in September 2008 multiplied by firm's dependency on bank credit (Bank Credit/(Bank Credit+Trade Credit)). All columns include City x Industry (NACE2) fixed effects. Standard errors are clustered at the Industry and City level, and are given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 16: REAL EFFECTS: THE ROLE OF BANK FX EXPECTATIONS

Change in Outcome Variable:	Firm Exposure to the Sudden Stop through ex-ante foreign funding of banks that the firm was working with prior to the sudden stop									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Firm Ex-Ante Exposure to the Sudden Stop (based on Bank Foreign Funding x FX Expectations)	-0.218*** (0.016)	-0.065** (0.028)	0.077*** (0.008)	-0.016 (0.022)	-0.090*** (0.013)	-0.036* (0.021)	-0.024** (0.012)	0.142 (0.090)	-0.075*** (0.004)	0.008 (0.018)
Firm Ex-Ante Exposure to the Sudden Stop (based on Bank Foreign Funding)		-1.340*** (0.299)		0.816*** (0.234)		-0.474** (0.186)		-1.461* (0.853)		-0.722*** (0.162)
Firm Log(Total Assets)	-0.019*** (0.002)	-0.017*** (0.003)	0.012** (0.005)	0.011** (0.005)	-0.029*** (0.003)	-0.028*** (0.003)	-0.012 (0.008)	-0.010* (0.005)	0.012*** (0.002)	0.013*** (0.002)
Firm Log(Capital/Total Assets)	0.029*** (0.002)	0.029*** (0.002)	0.027*** (0.003)	0.026*** (0.003)	0.035*** (0.003)	0.036*** (0.003)	0.002 (0.008)	0.003 (0.006)	0.006*** (0.001)	0.006*** (0.001)
Firm Exports/Sales	0.010 (0.016)	0.011 (0.016)	0.040 (0.030)	0.040 (0.030)	0.012 (0.021)	0.013 (0.021)	-0.129*** (0.015)	-0.128*** (0.025)	-0.003 (0.015)	-0.002 (0.015)
Firm Short-term Debt/Total Debt	-0.110*** (0.009)	-0.115*** (0.009)	0.115*** (0.018)	0.118*** (0.018)	-0.016 (0.010)	-0.018* (0.010)	-0.112*** (0.035)	-0.117*** (0.036)	0.004 (0.004)	0.001 (0.004)
Industry x City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	234,958	234,958	234,957	234,957	234,958	234,958	234,775	234,775	234,957	234,957
R-squared	0.027	0.028	0.017	0.018	0.029	0.030	0.014	0.014	0.021	0.021
Economic Impacts										
Change in the Outcome Variable for a firm that ex-ante and on average borrows more from higher foreign funding banks with pessimistic exp. (p75-p25)	-8.1	-2.4	2.9	-0.4	-3.4	-1.3	-0.9	5.3	-2.8	0.3
Change in the Outcome Variable for a firm that ex-ante and on average borrows more from higher foreign funding banks (p75-p25)		-7.2		4.4		-2.6		-7.9		-3.9

Notes: "Firm Exposure to the Sudden Stop" is defined as the weighted average foreign funding of banks that the firm is working with in September 2008 multiplied by firm's dependency on bank credit (Bank Credit/(Bank Credit+Trade Credit)). All columns include City x Industry (NACE2) fixed effects. Standard errors are clustered at the Industry and City level, and are given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 17: REAL NETWORK EFFECTS
(THE ROLE OF INDIRECT EXPOSURE TO THE SUDDEN STOP)

Firm Exposure to the Sudden Stop through banks that the firm was working with prior to the sudden stop, ...										
based on those banks':	Foreign Funding		Foreign Funding * FX Rollover Risk		Foreign Funding * FX Rollover Risk		Foreign Funding * FX Rollover Risk		Foreign Funding * FX Rollover Risk	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Change in Outcome Variable:	Δ (Bank Credit + Trade Credit)									Δ Total Debt
Firm Ex-ante Exposure to the Sudden Stop	-1.850 ^{***} (0.161)	-0.100 ^{***} (0.007)	-0.217 ^{***} (0.016)	0.689 ^{***} (0.088)	0.034 ^{***} (0.004)	0.077 ^{***} (0.009)	-0.755 ^{***} (0.113)	-0.041 ^{***} (0.006)	-0.090 ^{***} (0.013)	
Firm Ex-ante Indirect Exposure to the Sudden Stop	-0.695 ^{**} (0.309)	-0.049 ^{**} (0.024)	-0.085 ^{**} (0.042)	0.370 (0.338)	0.024 (0.020)	0.048 (0.042)	-0.231 (0.266)	-0.019 (0.020)	-0.025 (0.037)	
Firm Log(Total Assets)	-0.017 ^{***} (0.003)	-0.020 ^{***} (0.003)	-0.019 ^{***} (0.003)	0.011 ^{**} (0.005)	0.012 ^{***} (0.005)	0.012 ^{**} (0.005)	-0.028 ^{***} (0.003)	-0.029 ^{***} (0.003)	-0.029 ^{***} (0.003)	
Firm Log(Capital/Total Assets)	0.029 ^{***} (0.002)	0.028 ^{***} (0.002)	0.029 ^{***} (0.002)	0.026 ^{***} (0.003)	0.027 ^{***} (0.003)	0.027 ^{***} (0.003)	0.036 ^{***} (0.003)	0.035 ^{***} (0.003)	0.035 ^{***} (0.003)	
Firm Exports/Sales	0.013 (0.016)	0.011 (0.016)	0.011 (0.016)	0.039 (0.029)	0.040 (0.029)	0.040 (0.030)	0.013 (0.021)	0.012 (0.021)	0.012 (0.021)	
Firm Short-term Debt/Total Debt	-0.115 ^{***} (0.009)	-0.101 ^{***} (0.010)	-0.111 ^{***} (0.009)	0.118 ^{***} (0.018)	0.111 ^{***} (0.018)	0.115 ^{***} (0.018)	-0.018 [*] (0.010)	-0.012 (0.010)	-0.016 (0.010)	
Industry x City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	234,957	234,957	234,957	234,956	234,956	234,956	234,957	234,957	234,957	
R-squared	0.028	0.027	0.028	0.018	0.017	0.017	0.030	0.029	0.030	
<i>Economic Impacts</i>										
Change in the Outcome Variable										
for a firm with high vs. low exposure to the sudden stop										
direct effect (p75-p25)	-9.96	-6.38	-8.09	3.71	2.17	2.87	-4.06	-2.62	-3.35	
indirect effect (p75-p25)	-0.51	-0.46	-0.45	0.27	0.23	0.25	-0.17	-0.18	-0.13	
<i>[continued]</i>										
based on those banks':	Foreign Funding		Foreign Funding * FX Rollover Risk		Foreign Funding * FX Rollover Risk		Foreign Funding * FX Rollover Risk		Foreign Funding * FX Rollover Risk	
	(10)	(11)	(12)	(13)	(14)	(15)	(13)	(14)	(15)	
Change in Outcome Variable:	Δ Operating Profit									Δ Tangible Fixed Assets
Firm Ex-ante Exposure to the Sudden Stop	-0.334 ^{**} (0.152)	-0.006 (0.007)	-0.024 [*] (0.013)	-0.656 ^{***} (0.034)	-0.033 ^{***} (0.002)	-0.074 ^{***} (0.004)	-0.656 ^{***} (0.034)	-0.033 ^{***} (0.002)	-0.074 ^{***} (0.004)	
Firm Ex-ante Indirect Exposure to the Sudden Stop	-0.326 (1.107)	0.027 (0.068)	0.002 (0.149)	-0.378 ^{**} (0.178)	-0.029 ^{**} (0.011)	-0.048 ^{**} (0.022)	-0.378 ^{**} (0.178)	-0.029 ^{**} (0.011)	-0.048 ^{**} (0.022)	
Firm Log(Total Assets)	-0.011 (0.008)	-0.012 [*] (0.007)	-0.012 (0.008)	0.013 ^{***} (0.002)	0.011 ^{***} (0.002)	0.012 ^{***} (0.002)	0.013 ^{***} (0.002)	0.011 ^{***} (0.002)	0.012 ^{***} (0.002)	
Firm Log(Capital/Total Assets)	0.002 (0.007)	0.002 (0.007)	0.002 (0.007)	0.006 ^{***} (0.001)	0.006 ^{***} (0.001)	0.006 ^{***} (0.001)	0.006 ^{***} (0.001)	0.006 ^{***} (0.001)	0.006 ^{***} (0.001)	
Firm Exports/Sales	-0.129 ^{***} (0.017)	-0.129 ^{***} (0.021)	-0.129 ^{***} (0.019)	-0.002 (0.015)	-0.002 (0.015)	-0.002 (0.015)	-0.002 (0.015)	-0.002 (0.015)	-0.002 (0.015)	
Firm Short-term Debt/Total Debt	-0.117 ^{***} (0.036)	-0.108 ^{***} (0.035)	-0.112 ^{***} (0.035)	0.001 (0.004)	0.007 [*] (0.004)	0.003 (0.004)	0.001 (0.004)	0.007 [*] (0.004)	0.003 (0.004)	
Industry x City FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	234,774	234,774	234,774	234,957	234,957	234,957	234,957	234,957	234,957	
R-squared	0.014	0.014	0.014	0.021	0.021	0.021	0.021	0.021	0.021	
<i>Economic Impacts</i>										
Change in the Outcome Variable										
for a firm with high vs. low exposure to the sudden stop										
direct effect (p75-p25)	-1.80	-0.38	-0.89	-3.54	-2.11	-2.76	-4.06	-2.62	-3.35	
indirect effect (p75-p25)	-0.24	0.25	0.01	-0.28	-0.27	-0.25	-0.17	-0.18	-0.13	

Notes: Standard errors are clustered at the Industry and City level, and given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

TABLE 18: REAL NETWORK EFFECTS: MECHANISM
(REDUCTION IN DOWNSTREAM FIRM-TO-FIRM TRADE)

	Dependent Variable:							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$\Delta \text{Log}(\text{Firm-to-Firm Sales})$							
Supplier's Ex-ante Exposure to the Sudden Stop	-0.488*** (0.090)	-0.298*** (0.055)	-0.385*** (0.097)	-0.414*** (0.067)			-0.481*** (0.090)	-0.401*** (0.073)
Buyer's Ex-ante Exposure to the Sudden Stop					-0.125** (0.058)	-0.096* (0.059)	-0.212* (0.111)	-0.107 (0.075)
Supplier Log(Total Assets)				-0.003 (0.002)				-0.004 (0.002)
Supplier Log(Capital/Total Assets)				0.000 (0.002)				0.000 (0.002)
Supplier Export-to-Sales				-0.020 (0.015)				-0.061*** (0.016)
Supplier ST Debt / Total Debt				-0.061*** (0.013)				-0.071*** (0.014)
Buyer Log(Total Assets)						-0.006*** (0.002)		-0.006*** (0.002)
Buyer Log(Capital/Total Assets)						0.004*** (0.002)		0.007*** (0.002)
Buyer Export-to-Sales						-0.020 (0.013)		-0.046*** (0.015)
Buyer ST Debt / Total Debt						-0.015 (0.010)		-0.019 (0.013)
Buyer FE	No	Yes	--	Yes	--	--	No	No
Buyer x Supplier Industry x Supplier City FE	No	No	Yes	--	--	--	No	No
Supplier FE	--	--	--	--	Yes	Yes	No	No
Observations	1,029,244	985,054	282,742	985,054	808,442	985,054	985,054	808,442
R-squared	0.001	0.167	0.399	0.296	0.186	0.296	0.001	0.001
<i>Economic Impacts</i>								
Change in the (log) Firm-to-Firm Sales								
if supplier is more exposed to the sudden stop (p75-p25)	-2.81	-1.72	-2.22	-2.38	--	--	-2.77	-2.31
if buyer is more exposed to the sudden stop (p75-p25)	--	--	--	--	-0.28	-0.22	-0.48	-0.24

Notes: "Change in the (log) Firm-to-Firm Sales" is the log change in buyer's purchases from a supplier from the period (January 2008-September 2008) to (January 2009-September 2009). "Supplier's Ex-ante Exposure to the Sudden Stop" is the weighted average foreign funding of banks the supplier is working with. Similarly, "Buyer's Ex-ante Exposure to the Sudden Stop" is the weighted average of foreign funding of banks the buyer is working with. Both exposures are measured ex-ante. Industry is defined at the NACE2 level. Standard errors are clustered at the Buyer and Supplier level, and are given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

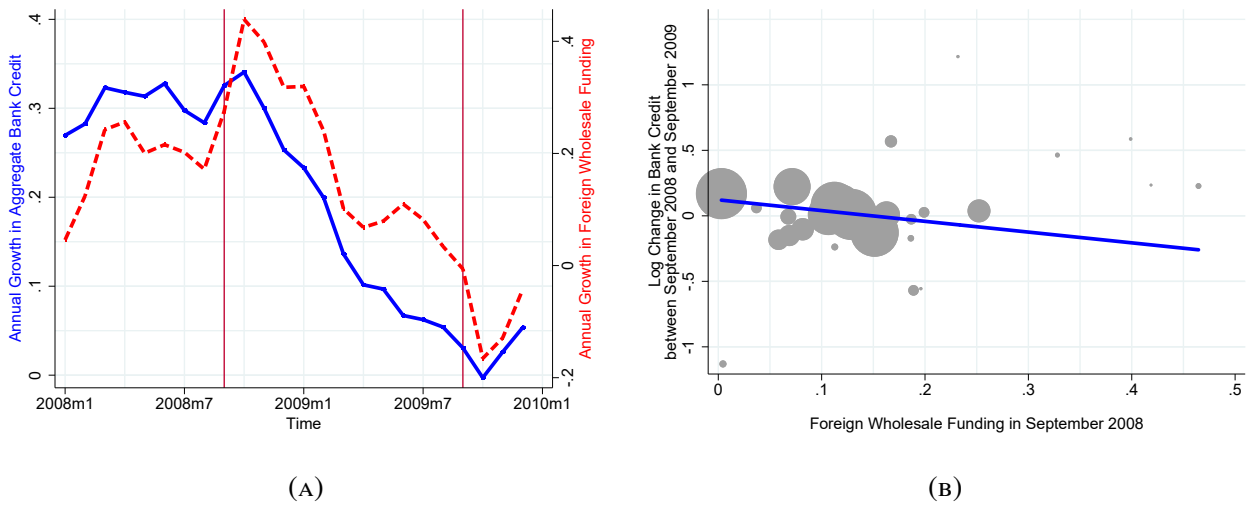
TABLE 19: REAL NETWORK EFFECTS: FURTHER INSIGHTS
(THE ROLE OF SUPPLIER MARKET CONCENTRATION)

	Change in Outcome Variable: Δ (Bank Credit + Trade Credit)					Δ Total Debt	Δ Operating Profits	Δ Tangible Fixed Assets
	(1)	(2)	(3)	(4)	(5)			
Supplier Market Concentration	0.367	-5.292**	-1.438	3.806	-1.561*			
.... * Firm Ex-ante Indirect Exposure to the Sudden Stop	(1.962)	(2.074)	(1.345)	(6.559)	(0.946)			
Supplier Market Concentration	-0.188***	-0.023	-0.162***	-0.205***	-0.068***			
	(0.014)	(0.016)	(0.013)	(0.074)	(0.011)			
Firm Ex-ante Exposure to the Sudden Stop	-0.395***	0.619***	0.141*	-0.521***	-0.564***			
	(0.130)	(0.085)	(0.081)	(0.181)	(0.067)			
Firm Ex-ante Indirect Exposure to the Sudden Stop	-1.355	-2.611***	-1.747**	2.094	-1.720***			
	(1.004)	(0.917)	(0.829)	(4.580)	(0.629)			
Firm Log(Total Assets)	-0.075***	0.001	-0.076***	-0.042***	-0.009**			
	(0.003)	(0.009)	(0.003)	(0.012)	(0.004)			
Firm Log(Capital/Total Assets)	0.035***	0.025***	0.040***	0.011	0.008***			
	(0.003)	(0.004)	(0.003)	(0.008)	(0.002)			
Firm Exports/Sales	0.015	0.041	0.014	-0.189***	-0.021*			
	(0.015)	(0.032)	(0.014)	(0.055)	(0.013)			
Firm Short-term Debt/Total Debt	-0.137***	0.174***	-0.028*	-0.068*	0.017*			
	(0.016)	(0.036)	(0.017)	(0.048)	(0.010)			
Industry x City FE	Yes	Yes	Yes	Yes	Yes			
Observations	103,349	103,349	103,349	103,316	103,349			
R-squared	0.046	0.025	0.053	0.022	0.027			
<i>Economic Impacts</i>								
Change in the Outcome Variable (%)								
for a firm with a concentrated supplier market (p75-p25)								
(evaluated at the mean of indirect exposure)	-7.84	-2.43	-7.24	-7.61	-4.15			
Indirect Effect								
(evaluated at the 25th percentile of Supplier Market Concentration)	-0.90	-0.05	-0.62	0.17	-0.41			
(evaluated at the 75th percentile of Supplier Market Concentration)	-0.85	-0.79	-0.83	0.70	-0.79			
Direct Effect	-2.21	3.47	0.79	-2.92	-3.16			

Notes: Firms' ex-ante exposure to the sudden stop are defined based on the weighted average foreign funding of banks that the firm was working with. Supplier Market Concentration is the (log) Herfindahl-Hirschman index for the supplier market of a given buyer (the squared root of summation of squared values of each supplier's weight in total supplier purchases of a given buyer). All columns include Industry (NACE2) x City fixed effects. Standard errors are clustered at the industry and city level, and given in parentheses. *** significant at 1%, ** significant at 5%, and * significant at 10%.

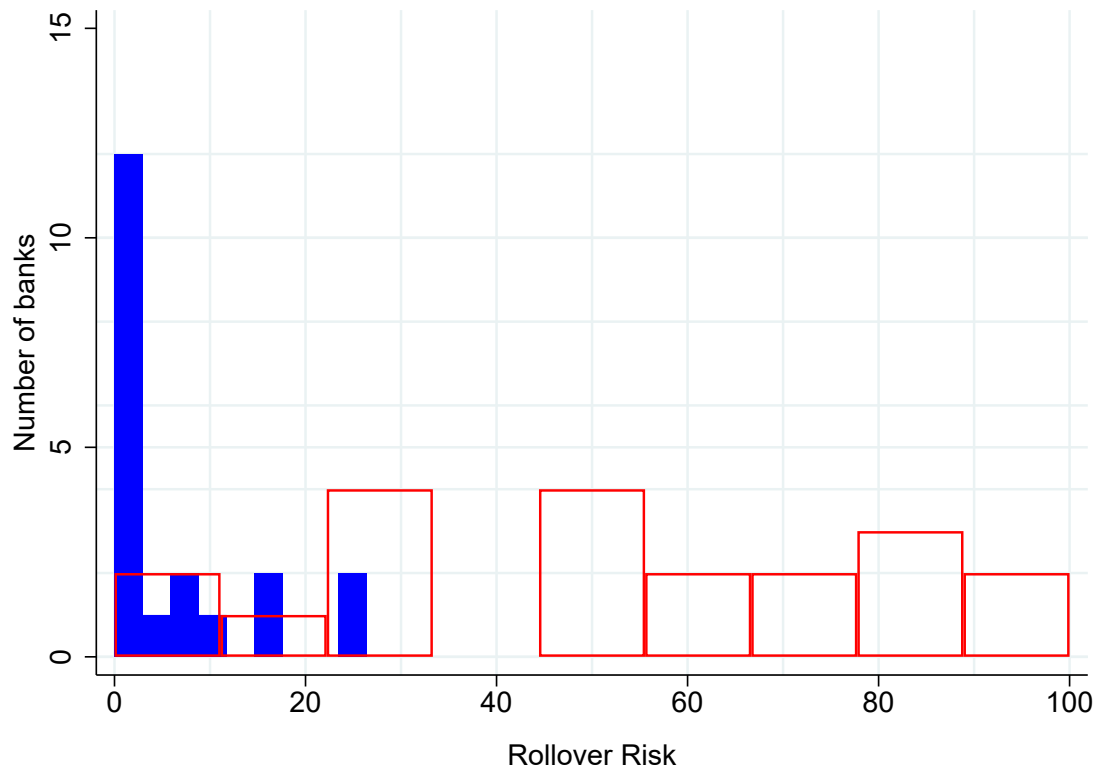
Figures

FIGURE 1: DOMESTIC CREDIT VS. BANK FOREIGN WHOLESALE FUNDING



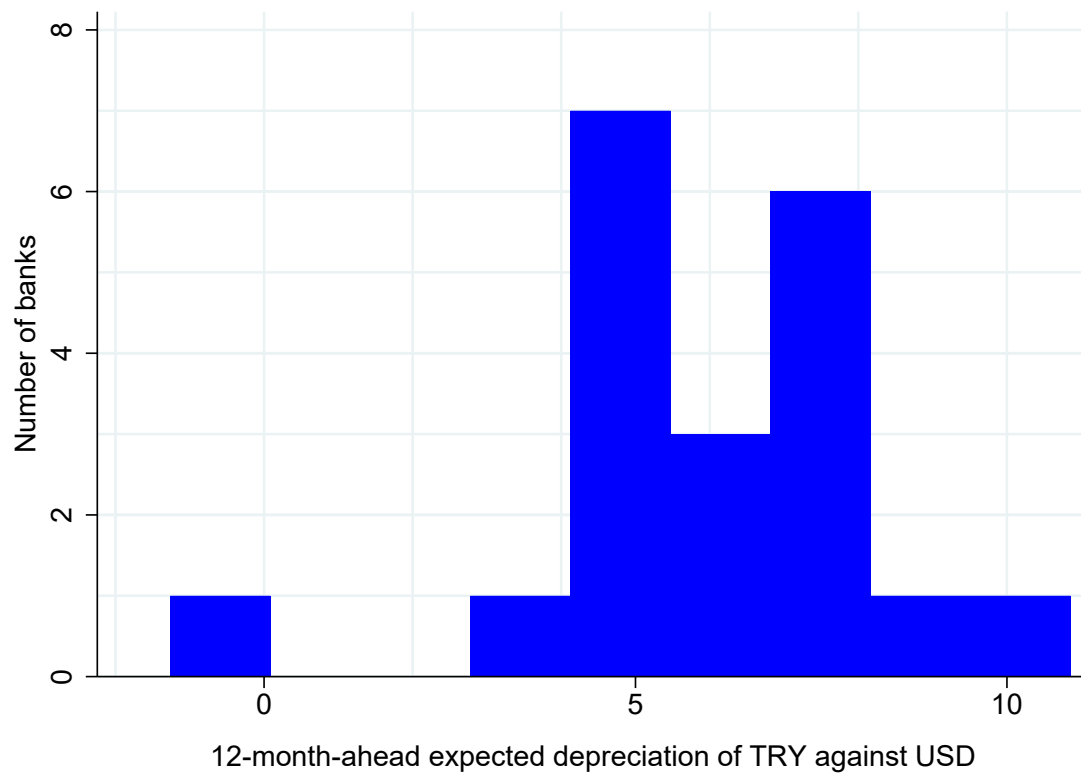
Note. The figure on the left (A) plots annual growth in total bank credit (solid line, left axis) and the annual growth in foreign wholesale funding (dashed line, right axis). Vertical solid lines correspond to September 2008 and September 2009. The figure on the right (B) plots log change in total bank credit from September 2008 to September 2008 against banks' foreign wholesale funding (in proportion to their assets) in September 2008. The circles are weighted by bank size. Source. Central Bank of the Republic of Turkey and Banking Regulation and Supervision Agency of Turkey.

FIGURE 2: HISTOGRAM OF BANK ROLLOVER RISKS



Note. The solid (blue) bars correspond to the histogram of our baseline measure of bank rollover risks, where rollover risk is defined as the ratio of ‘cross-border foreign-currency loans that is originated at least one year before September 2008 and that is prescheduled to mature within 8 months after the sudden stop’ to total cross-border foreign-currency loans in September 2008. The blank (red) bars correspond to the histogram of our alternative measure of bank rollover risk, where we take all cross-border foreign-currency loans –regardless of their origination date– that is prescheduled to mature within 8 months after the sudden stop (and similarly, we normalize this number with total cross-border foreign-currency loans in September 2008). For robustness, we also study different horizons into the sudden stop, cross-border loans that happen to be scheduled to mature within 4, 5, 6, or 7 months after the sudden stop.

FIGURE 3: HISTOGRAM OF BANK EXPECTATIONS



Note. The figure plots the histogram of banks' 12-month-ahead expected depreciation in the USD/TRY exchange rate, measured during the first two weeks of September 2008.

Appendix A. Extended Literature Review

Our paper is related to a large strand of literature on the international transmission of financial shocks, or more generally, on the real effects of credit supply shocks. [Schnabl \(2012\)](#), for instance, show that the 1998 Russian default has adverse real effects on Peruvian firms, via international banks reducing lending to Peruvian banks, and Peruvian banks, particularly domestically-owned banks that borrow internationally, reducing their supply of local credit. [Iyer et al. \(2014\)](#) and [Cingano et al. \(2016\)](#), the former for Portugal and the latter for Italy, show that banks that were ex-ante highly reliant on the European interbank market reduce their supply of credit more strongly in the aftermath of the market freeze. [Cingano et al. \(2016\)](#) further show that firms attached to affected banks reduce their investment and employment more strongly. [Ongena et al. \(2015\)](#) show in a multi-country setting that internationally-borrowing domestic and foreign-owned banks have significantly lower credit growth during the global financial crisis, and that the reduction in credit has adverse effects on firms' real performances. [di Giovanni et al. \(2018\)](#) show that when global risk aversion (VIX) is lower, domestically-owned banks in Turkey with higher level of non-core liabilities increase their supply of credit and reduce their loan rates, and that looser domestic credit market conditions are not particularly due to higher collateral values, but due to lower borrowing costs that make borrowers more able to pay back their loans. Finally, [Chodorow-Reich \(2014\)](#) and [Bentolila et al. \(2018\)](#) identify a significant adverse impact on employment of the drop in bank credit supply during the global financial crisis, the former for the US and the latter for Spain.

Our key contribution to this strand of literature is to uncover that banks' rollover risks in international wholesale markets and expectations about future funding conditions also matter for the credit supply channel, and that the reduction in bank credit supply has cascading real effects.

Our paper is also related to the recently growing literature on domestic production networks. [Barrot and Sauvagnat \(2016\)](#), for instance, show that suppliers affected by natural disasters pass significant output losses on their downstream firms, particularly when they produce essential inputs for the final production. [Tintelnot et al. \(2017\)](#) show that international trade shocks even affect firms that do not directly export and import. [Huneus \(2018\)](#) show that costly adjustment in buyer-supplier linkages amplifies the propagation of international trade shocks within the economy. Moreover, cost shocks propagate through domestic production networks, and eventually affect pricing of final goods in domestic markets ([Duprez and Magerman, 2018](#)) or in export destination markets ([Akgunduz and Fendoglu, 2019](#)).

Unlike real shocks such as natural disasters or trade shocks, here we focus on a financial shock

(the sudden stop). Relatedly, [Cingano et al. \(2016\)](#) show that Italian firms ex-ante borrowing more from affected banks –namely, from banks more reliant on the European interbank market funds at the onset of the market freeze– have a lower growth rate of trade credit in the aftermath of the shock. The reduction in aggregate trade credit at the firm level hints at the propagation of credit constraints. Using a large database on US firm-to-firm trade credit transactions, [Costello \(2019\)](#) show that firms that experienced larger decline in bank credit during the global financial crisis have reduced their trade credit to their clients, eventually leading downstream firms to reduce their employment. We differ from [Costello \(2019\)](#) by being able to offer a more precise measure for firm exposure to the credit supply shock –a virtue of having bank-firm level credit register. Moreover, we identify firm-to-firm linkages using domestic firm-to-firm sales data, which is administrative for value-added tax purposes, and covers nearly the universe.

Combining the input-output structure of 64 industries in Spain with the domestic Credit Register, [Alfaro et al. \(2019\)](#) report sizeable direct and indirect real effects of firm credit supply shocks (spanning expansion, crisis and recession years). Since the input-output structure is at the industry-level, they proxy firm-to-firm exposures by assuming that suppliers within the same industry affect their downstream firms symmetrically the same (and similarly for buyers within the same industry for their upstream firms). Moreover, they explore the mechanism via using firm-level balance sheets (accounts payable). Exploiting the firm-to-firm sales database, we essentially have the input-output structure at the buyer-supplier level, which enables us to reach sharper inferences, and further, to more precisely identify underlying mechanisms –by comparing supply of inputs to the same buyer by suppliers with different exposures to the sudden stop, or by comparing demand for inputs from the same supplier by buyers with different exposures to the sudden stop, or exploring whether more concentrated supplier market for a given buyer makes the identified indirect effects stronger–.

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