International Spillovers and Local Credit Cycles*

Julian di Giovanni† Şebnem Kalemli-Özcan‡ Mehmet Fatih Ulu§

Yusuf Soner Baskaya¶

September 2018

Abstract

This paper studies the impact of the Global Financial Cycle (GFC) on domestic credit market conditions in a large emerging market, Turkey, over 2003–13. We use administrative data covering the universe of corporate loan transactions matched to firm and bank balance sheets to provide evidence on four facts that are critical in the transmission of the GFC to emerging markets: (1) uncovered interest parity (UIP) is violated at the firm-bank level – firms pay a lower interest rate when borrowing in foreign currency from their domestic banks; (2) the UIP risk premium, both at the firm-bank level and at the country level, strongly co-moves with the GFC over time; (3) during the boom phase of the GFC, the UIP risk premium falls and capital flows into Turkey, lowering domestic borrowing costs and leads to an expansion of credit for domestic firms; and (4) firm-bank level data on pledged collateral on new loan issuances show that borrowing constraints do not relax during the boom phase of the GFC due to higher collateral values. Rather, firms are able to borrow more due to lower borrowing costs on average, which increases their ability to pay back their loans. We show that the GFC can explain 43% of observed corporate credit growth during our sample period.

JEL Classification: E0, F0, F1

Keywords: Capital Flows, VIX, Risk Premium, Bank Credit, Collateral Constraints

*We thank Koray Alper, Olivier Blanchard, Anusha Chari, Stijn Claessens, Gita Gopinath, Alberto Martin, Arnauld Mehl, Benoit Mojon, Romain Rancière, Hélène Rey, Jesse Schreger, Hyun Song Shin and participants at numerous conferences and seminars for their helpful comments. We thank Eda Gulsen who provided phenomenal research assistance. We also thank Galina Hale and Camille Minoau for the data on syndicated loans. The views expressed herein are those of the authors and not necessarily those of the Central Bank of the Republic of Turkey. Di Giovanni gratefully acknowledges the Spanish Ministry of Economy and Competitiveness, through the Severo Ochoa Programme for Centres of Excellence in R&D (SEV-2015-0563) for financial support.

†ICREA; Universitat Pompeu Fabra; Barcelona GSE; CREI; and CEPR (julian.digiovanni@upf.edu)

‡Department of Economics, University of Maryland; CEPR; and NBER (kalemli@econ.umd.edu)

§Central Bank of the Republic of Turkey (fatih.ulu@tcmb.gov.tr)

¶Glasgow University (soner.baskaya@gmail.com)

1 Introduction

The Global Financial Cycle (GFC) is defined as synchronized surges and retrenchments in gross capital flows, and booms and busts in risky asset prices and leverage (Rey, 2013). The GFC has a strong common component that comoves with VIX,[1] which in turn is related to monetary policy in the US, and to changes in risk aversion and uncertainty (Bekaert et al., 2013; Miranda-Agrippino and Rey, 2018). Jordà et al. (2017) show that the increased synchronization of risky asset prices and capital flows can be explained by the risk appetite component of asset prices.

We study how the GFC affects domestic credit market conditions at the *microeconomic level* for a large emerging market economy. Our empirical methodology exploits data on the universe of loan transactions, including loan-level interest rates and other loan characteristics, between banks and firms for Turkey over 2003–13, combined with bank balance sheet information. By exploiting these granular data that covers the entire non-financial corporate sector, we not only trace out the effects that GFC-related capital flows have on lending patterns between banks and firms, and quantify their aggregate impact on domestic credit growth, but we also provide causal evidence on the underlying mechanisms at the micro level for this aggregate effect. Our results thus complement the literature that has so far focused on how the GFC (as proxied by movements in VIX) affects cross-border capital flows, asset prices, and credit growth using *aggregate* cross-country data (e.g., Forbes and Warnock, 2012; Cerutti et al., 2015; Fratzscher et al., 2016; Miranda-Agrippino and Rey, 2018).

Our paper makes two main contributions. First, we provide evidence on the causal effects of the supply-driven, that is the GFC (VIX)-driven, capital flows on borrowing costs and credit growth at the *firm-bank* level. These results are economically significant. We find a baseline micro estimate of the elasticity of domestic loan growth with respect to changes in VIX equal to -0.067. In turn, this *micro* estimate implies that we can explain, on average, 43% of the observed cyclical loan growth of the *aggregate* corporate sector over the sample period.[2] The micro estimate of the elasticity of the interest rate with respect to changes in VIX in our core specification is 0.019, implying a 1 percentage point fall in the borrowing costs for the average firm during the boom phase of the GFC.[3]

[1] VIX is a forward-looking volatility index of the Chicago Board Options Exchange. It measures the market's expectation of 30-day volatility, and is constructed using the implied volatilities of a wide range of S&P 500 index options.

[2] We provide details of this calculation below, where using the loan shares from each bank, we aggregate the average impact of changes in VIX on loan growth.

[3] The elasticities are calculated using the interquartile range of log (VIX) over the sample period.

Our second contribution is to provide novel evidence on the channels through which the GFC is transmitted to the domestic credit market by exploiting detailed loan-level data. Our findings highlight two important mechanisms that have recently been emphasized in the literature, and that are related: (i) there is a violation to the UIP condition at the micro level; that is, firms can borrow at cheaper terms from the domestic banks if they borrow in foreign currency instead of local currency and the strength of this "UIP risk premium" on local currency loans comoves with VIX, and (ii) loan-level collateral constraints do not relax during VIX driven capital inflow periods via higher collateral values, while the average firm can borrow at lower rates during such episodes.

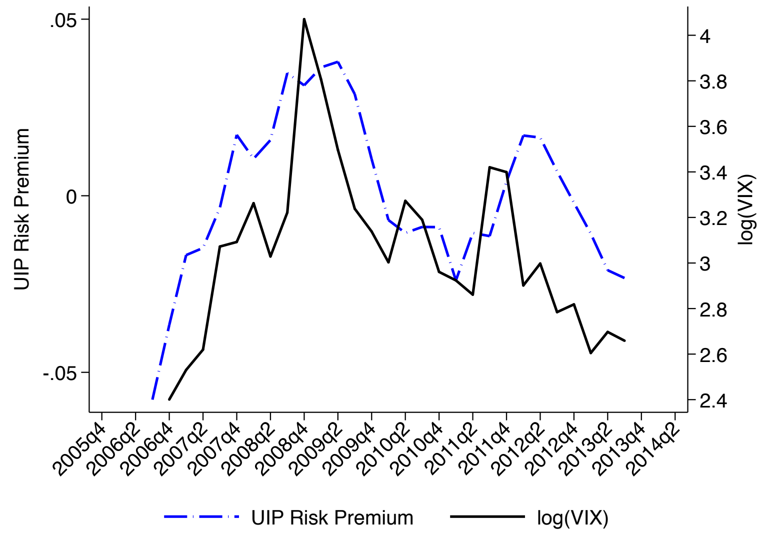
The finding on the micro-level UIP violation does not depend on any firm, bank or loan characteristics such as being an exporter, a foreign bank, or borrowing short-term. By keeping the firm-bank pair fixed, we show that the same firm borrowing from the same bank pays a lower interest rate on its comparable foreign currency loan relative to its local currency loan.[4] We show the cyclicality in the micro-level UIP violation by interacting an indicator variable for the currency composition of the loan with VIX in a difference-in-differences framework. Although borrowing in foreign currency is always cheaper on average, the difference-in-differences regression reveals that the cost of local currency loans fall more relative to foreign currency borrowing when VIX is low and vice versa. Given the fact that only half of the domestic credit supply is in foreign currency and the other half is in local currency, such cylicality in the UIP risk premium leads to an increase in local currency borrowing during the boom phase of the GFC.

To the best of our knowledge, this empirical result is novel and it is not straightforward to rationalize it with the existing models that assume an exogenous country-level UIP violation (see Gopinath and Stein, 2017, for a recent contribution that endogenizes this violation for a representative bank/firm). Our results at the firm-bank-time level also hold in the aggregate, where the aggregate UIP risk premium that favors foreign currency borrowing on average, is time-varying and strongly co-moves with VIX. The cost of borrowing in domestic currency increases during high VIX episodes (bust phase of the GFC), and falls during low VIX periods (boom phase of the GFC).[5] Figure 1 highlights this cyclicality by plotting VIX along with the UIP risk premium, which is calculated based on a standard UIP regression using aggregated Turkish lira (TL) loan-level interest rate data, the US federal funds rate, and the expected TL/US dollar exchange rate. The correlation between the aggregate UIP risk premium and VIX is 0.710.

[4]We show that this result holds for both short- and long-term maturities of loans.

[5]On average, foreign currency borrowing remains cheaper as long as the UIP deviation stays different than zero.

Figure 1. Comovement of VIX and UIP Risk Premium: Based on Turkish Lira Aggregated Loan-Level Interest Rate Data



Notes: This figure plots the UIP risk premium and the natural logarithm of VIX. The UIP risk premium is calculated as the residual from running the standard UIP regression (with a time trend) between Turkey and the US: $i_t - i^*_t = \alpha + \lambda_t + \beta \mathbb{E}_t \Delta e_{TL/USD,t+1} + \epsilon_t$, where i denotes the (annualized) the Turkish interest rate is calculated as the loan value weighted average of all Turkish lira (TL) loans outstanding in a given quarter t and i^* is the US Fed Funds rate rate at time t. Exchange rate expectations are based on data from a survey of forecasters of the one-year ahead expected Turkish lira-US dollar, which are collected at the monthly frequency. The expected quarterly (t to $t+1$) exchange rate change, $\mathbb{E}_t \Delta e_{TL/US,t+1}$, is calculated by taking the difference of these quarterly average of the monthly expectations. These data run from 2006Q4–2013Q4. λ_t denotes the time trend. The estimated coefficient (standard error) on expected exchange rate changes is 0.191 (0.127), the regression's R-square is 0.131. See Table A1.

These results are complementary to the result that global banks' US dollar lending increases during the boom phase of the GFC due to abundant liquidity in US dollar funding markets (Bruno and Shin, 2015a). When the UIP risk premium falls due to a fall in VIX, global banks provide more dollar funding to domestic banks at a lower cost, and domestic banks in turn provide more funding to domestic firms at a lower cost; a mechanism of pass-through from lower cost of funding for domestic banks to lower cost of borrowing for domestic firms.[6] Baskaya et al. (2017) show that during capital inflow episodes into Turkey, banks that fund themselves internationally expand their credit supply. These banks are both large and have a high non-core liability ratio, which is shown to be largely composed of foreign liabilities and thus is tightly correlated with capital flows into the banking sector. In this paper, we provide the novel result that banks with a high non-core liability ratio reduce their lending rates relatively more during periods of low VIX, since the importance

[6] In fast growing bank-based emerging markets, domestic bank intermediation of capital inflows is typical since domestic deposits are not enough to fund banks who in turn finance growth. See Reinhart and Rogoff (2009) and Hahm et al. (2013).

of international funding in their liability structure exposes them relatively more to the GFC than other domestic banks.

The second mechanism we explore is how firms' financial constraints relax as a result of VIX-driven capital flows. We find that the main mechanism underlying the relaxation of financial constraints is rather different than the standard "higher asset prices–higher collateral–more borrowing" channel. This channel rests on models where the liquidation value of physical assets serve as the collateral that determines the amount of borrowing by firms, and this collateral value may fluctuate with aggregate shocks that affect asset prices.[7] Our data on pledged collateral at the loans' origination reveals that the effect of the collateral value on the loan amount does not respond significantly to fluctuations in VIX. We use data at the loan-level and not at the firm-level in order to identify the effect of GFC on credit constraints since for identification we need to control explicitly for time-varying firm-level demand shocks via the use of firm×quarter fixed effects (e.g., Khwaja and Mian, 2008; Chodorow-Reich, 2014; Jiménez et al., 2014). This is important since as Guerrieri and Lorenzoni (2017) show in a heterogeneous agent environment, shocks to the agents' borrowing capacity affect both borrowers' demand for loans and lenders' supply of loans, and we want to solely focus on the supply side.

We therefore run difference-in-differences regressions using data on collateral, price and quantity of the loan at the loan-firm-bank-month level. In our most stringent specification, these loan-level regressions are identified from differences in new loan issuances for the *same* firm-bank pair in a given period, allowing us to use bank×firm×month effects. Since there are enough new loans in a given month between a given firm-bank pair, we can identify the effect of VIX on the relation between collateral posted for each loan and the price and amount of the loan. These regressions also guard against the possibility of firms switching banks as a response to capital flows, and hence against the possibility of selection in firm-bank matches driving our results. For a given firm-bank pair, we show that a relaxation in collateral constraints during boom periods of the GFC is minimal and not quantitatively important for loan volumes. Crucially, this collateral channel also does not impact borrowing costs for new loans, once time-varying firm credit risk is accounted for via firm×month fixed effects. Rather, irrespective of collateral levels, firms are able to borrow more as a result of lower interest rates on average given a fall in the risk premium, which in turn

[7] Classic closed-economy models that focus on industrial economies are Bernanke et al. (1999), Kiyotaki and Moore (1997), Bernanke and Gertler (1989). There are open economy models that use a similar setting to explain sudden stops, as opposed to booms which is our focus, where an international collateral constraint binds during the sudden stop, such as Calvo (1998), Caballero and Krishnamurthy (2001) and Mendoza (2010). See also Caballero and Simsek (2016); Farhi and Werning (2016); Gopinath et al. (2017).

increases firms' ability to repay their loans. For example, a 100,000 lira loan still requires 10% of the firm's capital stock as collateral, but due to VIX-driven capital inflows such a loan can now be financed at 3% instead of 8%.

This result is important in helping to identify two alternative margins of adjustment in the domestic credit market: it is possible for firms to borrow at lower rates on average, while their "hard" collateral constraints do not change much over the boom part of the cycle. Thus, "risky" firms are still allowed to borrow only some fraction of their capital stock, and this amount may not change if the value of the capital stock does not change much when capital flows into the banking sector as oppose to the corporate sector (see Fostel and Geanakoplos, 2015, for a theoretical contribution that rationalizes this channel).

The interpretation of our results rests on the assumption that country risk, and the UIP risk premium, fall because of declines in VIX. It is also plausible that country risk falls due to good domestic policies and improved country fundamentals, which will trigger capital inflows. Rogers et al. (2016) and Chari et al. (2017) show that global financial conditions and country risk premiums are in general correlated. In our case, since we want to show causality, we instrument capital inflows into Turkey by VIX, and run a two-stage instrumental variables regression. As discussed above there is already a literature that shows a strong relation between VIX and total capital flows, thus providing evidence on the strength of our first-stage regression for many countries. We argue here in addition to this literature that VIX is a valid instrument for capital inflows into Turkey given the cyclical relation between VIX and the UIP risk premium. During low levels of VIX, risk-aversion and volatility are low and investors are more willing to tolerate higher levels of country risk associated with investing in emerging markets. If country risk has a global component and a country-specific component, country risk will go down as VIX falls.

At the same time, movements in VIX may be related to US monetary policy and if Turkish monetary policy responds to US policy. Therefore, Turkish firms' expectations of future economic conditions will be correlated with VIX through Turkish monetary policy and this will affect their credit demand.

To rule out the concern that these demand effects will contaminate our estimated supply-side VIX effect in our baseline "macro" regressions, we control for Turkish monetary policy and domestic fundamentals, such as GDP, the exchange rate, inflation, and expectations of these variables. Furthermore, we undertake two diagnostic checks. First, we make use of the fact that we have data on both the price and quantity of loans. The standard theory of loanable funds market predicts an increase in the credit volume with a positive shock regardless if this is a supply or demand shock to credit. However, the lending rate will go down if the positive supply shock dominates the positive demand shock. Hence, this exercise can validate our identifying assumption by comparing the OLS and IV estimated coefficients on capital inflows for the firm-level borrowing cost regressions. Second, we control explicitly for time-varying firm demand in the regressions that examine the role of internationally funded domestic banks, where we exploit the differential in banks non-core liabilities ratios. These regressions are an extension of the macro regressions that study the direct effect of the GFC on borrowing costs, but the quantitative importance of these large internationally funded banks in driving the transmission of the GFC helps support our identifying assumption that VIX picks up supply-driven capital inflows.

Our IV regressions deliver strong results. VIX is a robust predictor of capital flows, and the elasticity of the interest rate with respect to capital inflows is twice as large for the VIX-instrumented capital inflows regression compared to the OLS estimate, which is what one would expect based on our theoretical validation of our identifying assumption. Since demand- and supply-driven capital flows have opposite effects on borrowing rates, this biases the OLS coefficient on these rates towards zero and the IV coefficient capturing only the supply shock is larger in absolute value. Furthermore, the results in the regressions that are identified via the differential in how large-internationally funded banks transmit the GFC is stark: our point estimates for the borrowing costs, once controlling for time varying firm demand, are almost identical. The point estimates for the loan volumes imply that these banks can explain as much as 95% of the 43% of average credit growth that is calculated from our baseline macro regression that estimates the direct effect of VIX.

We conduct multiple robustness checks such as excluding the global crisis episode of 2008 in order to make sure our results are not solely identified from the large spike in VIX during the global financial crisis, which constitutes a single negative credit supply shock. Our results are driven by quarter-to-quarter changes of VIX over the whole sample period. Most of these quarter-to-quarter changes in VIX are associated with positive credit supply shocks given the fact that during our sample period Turkey was a net borrower, mostly being on the receiving side of capital inflows.[8] We also explore another potentially important channel: the role of exchange rates. Our baseline macro regressions show that the fluctuations in the actual and expected Turkish Lira/USD exchange

[8] We further show that are results are not driven by direct lending of foreign banks to the corporate sector as highlighted in Peek and Rosengren (2000); Cetorelli and Goldberg (2011); Schnabl (2012); Morais et al. (2015).

rate, cannot explain the interest rate differential at the firm-bank level between local and foreign currency loans – this is the UIP violation. However, an appreciating exchange rate as a result of capital inflows may have compositional effects, allowing banks and firms with currency mismatch on their balance sheet to take on more leverage in terms of increasing the share of foreign currency debt (e.g., Bruno and Shin, 2015b). We find support for highly leveraged banks lending more but these banks are not necessarily lending more to a particular set of firms that have balance sheet mismatches in terms of the currency composition of their liabilities and assets when the exchange rate appreciates. Consistent with this, there is also no differential impact of the exchange rate appreciations on borrowing costs for firms with balance sheet mismatches.

Section 2 presents our conceptual framework that connects the country-level UIP violation to a micro-level one at the firm-bank level. Section 3 describes the data. Section 4 and Section 5 present the identification methodology, main empirical results, and robustness. Section 6 concludes.

2 Conceptual Framework

We start with the *deviation* from the standard no-arbitrage condition for a foreign lender to Turkey implied by uncovered interest rate parity (UIP) with country risk. That is, our definition of the UIP violation is when the following equality does not hold: $i_{c,t} = i_t^* + \mathbb{E}_t \Delta e_{t+1}$. In our case it does not hold due to country risk:

$$i_{c,t} = i_t^* + \mathbb{E}_t \Delta e_{t+1} + \gamma_{c,t}, \tag{1}$$

where $i_{c,t}$ and i_t^* are the nominal interest rates in Turkey and the US (foreign), respectively; $\mathbb{E}_t \Delta e_{t+1}$ is the expected log exchange rate change between t and $t+1$, and $\gamma_{c,t}$ is a country risk premium. The Turkish interest rate should exceed i_t^* by the amount of an expected depreciation of the Turkish lira relative to the US dollar (i.e., $\mathbb{E}_t \Delta e_{t+1} > 0$), and by the country risk premium $\gamma_{c,t}$. Therefore, a fall in interest rates in a small-open economy can result from a decline in exchange rate and default risks, which will also facilitate capital mobility. If Turkish nominal interest rates are higher than those of the US, say due to higher country risk, a fall in this risk premium attracts capital flows, leads to a decline in nominal interest rates and also to an appreciation of the Turkish lira viz. the US dollar, leading to lower borrowing costs. Increased risk appetite of investors worldwide, and the accompanying fall in VIX, can then be thought of as an exogenous factor that leads to a fall in a country's risk premium, given the lower weight that investors place on country risk. That is, we can think of $\gamma_{c,t}$ as being composed of two different risks: global and country. We therefore write

$\gamma_{c,t}$ as

$$\gamma_{c,t} \equiv \omega \text{VIX}_t + \alpha_{c,t}, \tag{2}$$

where VIX represents global risk and hence a proxy for the GFC; ω needs not equal to one, and $\alpha_{c,t}$ is country-specific risk.

This framework is consistent with the literature that shows that UIP deviations are related to a time-varying risk premium, which is related to country/political risk (see among others Chinn and Frankel, 2002; Frankel and Poonawala, 2010; Hassan, 2013). This literature models the violation to be exogenous by assuming an exogenous shock to $\gamma_{c,t}$ as in Engel (2016). The recent work by Salomao and Varela (2016) models the optimal choice of foreign currency borrowing by firms, assuming again an exogenous UIP violation due to country risk that makes the foreign currency borrowing cheaper. See also Maggiori et al. (2017) who show, using transaction-level data from Morningstar, that emerging market firms only borrow in foreign currency from mutual fund investors.

A recent exception that endogenizes the UIP violation is Gopinath and Stein (2017). In their model, cheaper borrowing in foreign currency at the country-level arises as an equilibrium condition due to local banks' comparative disadvantage in creating dollar safe claims out of local-currency-denominated collateral. Thus, local banks will only be willing to fund local projects with dollar borrowing if doing so is cheaper than funding with domestic deposits. And this will only happen in equilibrium if local demand for dollars is large relative to the exogenous supply of safe dollar claims that are available from abroad. Hence, this model provides a rationale for our findings: the amount and cost of dollar borrowing relative to local currency borrowing is a function of global dollar funding supply. Our evidence both at the country and at the firm-bank level supports this line of reasoning.

To carry our framework from the aggregate to the micro level, we assume that the risk premium for a given firm f by bank b is linear in firm-specific risk:

$$\gamma_{f,b,t} \equiv \alpha_{f,t}, \tag{3}$$

where $\alpha_{f,t}$ represent time-varying firm risk. Then, we can write the nominal interest rate at the firm-bank level as a linear function of the country interest rate (1) and the risk premium (3), and apply the definition of the country risk factor (2):

$$\begin{aligned} i_{f,b,t} &= i_{c,t} + \gamma_{f,b,t} \\ &= i^*_t + \mathbb{E}_t(\Delta e_{t+1}) + \gamma_{c,t} + \gamma_{f,b,t} \\ &= i^*_t + \mathbb{E}_t(\Delta e_{t+1}) + \omega \text{VIX}_t + \alpha_{c,t} + \alpha_{f,t}, \end{aligned} \tag{4}$$

where the nominal interest rate at the firm level is now a function of the foreign interest rate, expected exchange rate changes, global and country risk factors, in addition to time-varying firm risk. Therefore, conditional on the US (foreign) interest rate, country risk, and firm-time varying factors including idiosyncratic risk, borrowing costs at the firm level will be a function of the GFC, proxied by VIX. We take this simple framework to the data by using an estimation equation for the firm-bank level interest rates at the quarterly level as in equation (4).

3 Data

To identify the impact of the GFC on the domestic credit cycle, we merge two large micro-level panel datasets that are official registeries. All data are administrative and obtained from the Central Bank of Republic of Turkey (CBRT). Specifically, we merge bank-level balance sheets with individual loan-level data between banks and firms using unique bank and firm identifiers. We further augment this dataset with Turkish and world macroeconomic and financial data. The final dataset is at the quarterly frequency and covers the universe of loans and every balance sheet item in the banks' regulatory filings. We transform all loan and bank variables to real values, using 2003 as the base year for inflation adjustment. We further clean and winsorize the data in order to eliminate the impact of outliers.[9] We discuss the characteristics of each dataset in this section.

3.1 Credit Register

Our detailed monthly loan transaction-level data are collected by the Banking Regulation and Supervision Agency (BRSA), and provided to us by the CBRT. Banks have to report outstanding loans at the level of firms and individuals monthly to the BRSA at the transaction level.[10] For instance, if a firm has five loans with different maturities and interest rates at the branch of a bank and two other loans at another branch of the same bank, the bank then has to report all seven

[9]We winsorize 1% of the data for the loan and bank variables.

[10]There is a cutoff under which banks do not have to report the individual transactions to the authorities, which is 500 TL.

loans separately as long as each of the loans' outstanding amounts are above the bank-specific reporting cutoff level. If a loan's outstanding amount is below the bank's reporting cutoff then the bank may aggregate such small loans at the branch-level and report the aggregated amounts. This dataset provides the same information as found in credit register data in other countries, but contains a more comprehensive list of variables. In particular, besides providing the amount of a loan outstanding between a given individual (household, firm, government) and a bank, the dataset also provides several other key pieces of information, such as the (i) interest rate; (ii) maturity date as well as extended maturity dates if relevant; (iii) collateral provided; (iv) credit limit (only beginning in 2007); (v) currency of loan; (vi) detailed industry codes for the activity classification for which the loan is borrowed for, as well as the breakdown of consumer usage of loan (e.g., credit card, mortgage); (vii) bank-determined risk measures of the loans.

The data are cleaned at the loan level before we aggregate up to the firm-bank level for our regression analysis. The data cleaning is extensive and there are certain unique features of the Turkish data which must be tackled and which we describe in brief next. First, we use cash loans in terms of outstanding principal, since credit limit data are not available for the full sample period. Moreover, these loans naturally map into the data used to measure aggregate credit growth. Second, a significant component of lending in Turkey takes place in foreign currency (FX).[11] We clean the data to deal with exchange rate issues as follows. There are two types of FX loans, which banks report differently in terms of Turkish lira (TL) each month. The first type of FX loan is one that is indexed to exchange rate movements. This type of loan is reported based on its initial TL value each period, and thus is not adjusted by banks for exchange rate movements (of course, the value of these types of loans may still change if borrowers pay back some of the loan, for example). The second type of FX loan is issued in the foreign currency. The TL value of this type of loan is adjusted each period to account for exchange rate movements. This naturally creates a *valuation effect*, which we need to correct for in order to not under/overstate the value of the TL loan in the period following the initial loan issuance. For example, imagine that over a month period there are no new loans issued and no repayments made. A depreciation of the TL against the USD would appear to increase total loans outstanding for all existing FX loans issued in dollars. This valuation effect would in turn manifest itself as an expansion of credit when measured in TL, but this expansion would solely have been due to a currency depreciation, rather than issues of new loans. We adjust for this valuation effect using official end-of-period exchange rates, before

[11] Generally USD or euro.

summing the data over firm-bank pairs for FX and TL loans, where we sum all FX loans (expressed in TL).

We then adjust the individual loans for inflation before summing across firm-bank pairs. The baseline regressions pool loans regardless of their maturity. Roughly half of the loans have maturities less than or equal to one year. We therefore also run regressions splitting the sample at the one-year mark for short and long maturities.

We use end-of-quarter data for a given firm-bank pair. The key reason for doing so is that capital flows and other macro/global variables are at the quarterly level. The final cleaned dataset, before aggregation to the firm-bank level for a given quarter, contains roughly 53 million loan records over the December 2003–December 2013 period. Figure A1 compares the growth rate of the aggregated loans in our dataset ('Firms') to aggregate credit growth for the whole economy ('Firms + Non-Firms'). The two series track each other very closely, with a correlation of 0.86. Of the whole sample of corporate loans, roughly one half of the loans are in TL, and the remaining FX. Table A2 reports some key statistics on the coverage of the credit register data based on end-of-year data. We report the FX share of loans based on value within the respective firm datasets in Panels A and B. On average, this number is 50%. Therefore, both Turkish lira and foreign currency loans make up an important part of our sample in terms of value. The last two columns, columns (2) and (3), break this ratio up into loans that are issued in foreign currency ('FX Loan') and those that are issued in TL, but indexed to the exchange rate ('Indexed Loan'). The FX loans make up the majority of total foreign currency loans, though indexed loans having been rising in importance over last few years.

Table A3 reports summary statistics on banks, firms, and firm-bank pairs in the register for the end of year. As column (1) shows, the number of banks increase somewhat over the sample due to data collection for "participation" banks starting later. Similarly, the number of firms borrowing also increases, as reflected in the second column. The total number of firm-bank-quarter pairs in the full sample data is roughly 5.4 million (panel A, sum of columns (3) and (4)). Firms with multiple bank relationships make up approximately 50% of total loans in terms of loan count (column 5), and 75-88% as a share of total loan value (column (6)). Finally, the average number of banking relationships a given firm has over the sample is 2.8 (column 7).

Table A4 presents summary statistics for the credit register data for loans aggregated at the firm-bank pair each quarter. The table pools all the loans, regardless of currency of denomination in panel A, while panels B and C present statistics on TL and FX loans separately (i.e., the unit of observation is firm-bank-denomination). The table reports summary statistics for (i) loans outstanding in thousands of 2003 TL, (ii) the nominal interest rate, (iii) the real interest rate, and (iv) the remaining maturity (in months) of a loan. Furthermore, we do this for each currency type of loan. These are the data that form the basis for our regression samples.[12] As one can see, there is a lot of heterogeneity in the size of loans, as well as borrowing rates. In comparing panels A and B, one also sees that FX loans are on average larger and cheaper than TL loans.

Since we are aggregating over several potential loans between a given bank and firm pair in a given time period, we need to take into account the size of the individual loans in calculating an "effective" interest rate and maturity for the firm-bank pair. We do this by creating weighted averages based on a loan's share in total loans between each firm-bank pair in a given period. We allow the weights to vary depending on the unit of analysis we consider, and they also vary over time. Larger loans' interest rates get a bigger weight.[13] We want the weights to be time-varying to capture the time variation in the interest rates of the loan portfolio of a given firm-bank pair. Therefore, in panel A, when we pool the TL and FX loans, the weight's numerator is simply the loan value of an individual loan, while its denominator is the sum of all TL and FX loans between a firm-bank pair in a given period. In panels B and C, the weight's numerator is again the individual loan value, while the denominator is total TL loans in panel B, and in panel C the denominator is total FX loans.[14] The loan variable is the sum of all loans between firm-bank pairs, while the collateral ratio is simply the sum of collateral divided by the sum of loans between banks and firms in a given quarter. We always pool the data for FX and TL loans and do not sum these loans.

3.2 Bank-Level Data

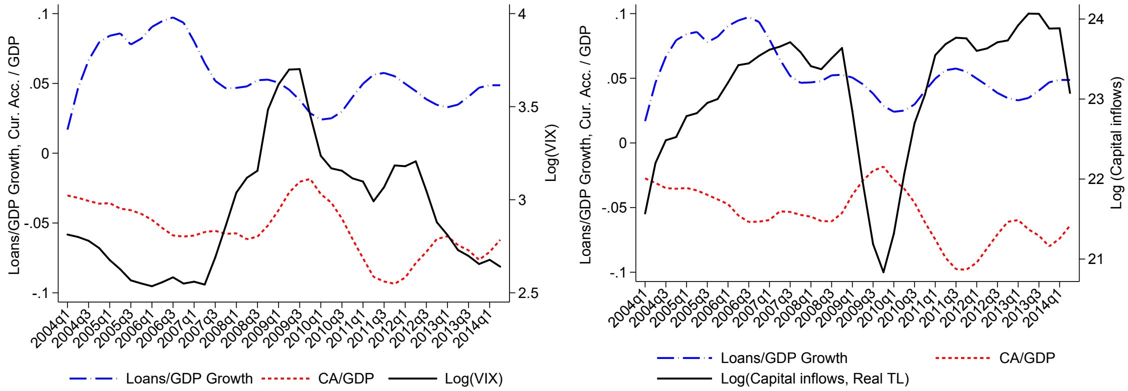
Turkey, like many major emerging markets, has a bank dominated financial sector: in 2014, banks held 86% of the country's financial assets and roughly 90% of total financial liabilities. The past decade has witnessed a doubling of bank deposits and assets, while loans have increased five-fold. As Table A5 shows, by 2013 the banking sector's assets represented more than 100 percent of GDP, and loans roughly 70 percent. This growth has been driven by a skewed banking sector, where the largest five banks hold between 50 to 60 percent of assets, deposits and loans over the sample

[12] The min-max values are similar across panels due to winsorization.

[13] We follow the same strategy in calculating weighted averages across different maturities.

[14] Formally, for a loan i between bank b and firm f in time t and denomination type $d = \{ALL, TL, FX\}$, in panel A: $w^{ALL}_{i,f,b,t} = Loan_{i,f,b,t} / \sum_{i \in I^{ALL}_{f,b,t}} Loan_{i,f,b,t}$; panel B: $w^{TL}_{i,f,b,t} = Loan_{i,f,b,t} / \sum_{i \in I^{TL}_{f,b,t}} Loan_{i,f,b,t}$; panel C: $w^{FX}_{i,f,b,t} = Loan_{i,f,b,t} / \sum_{i \in I^{FX}_{f,b,t}} Loan_{i,f,b,t}$, where $I^{d}_{i,f,b,t}$ is the set of loans based on currency types between the firm-bank pair in a given quarter.

Figure 2. Capital Flows, VIX, and Credit Growth in Turkey, 2004–13



(a) log(VIX) **(b)** Capital Inflows

Notes: These figures plot Turkey's Loans/GDP and CA/GDP ratios over time with (a) log(VIX) and (b) Turkish capital inflows. Turkey's Loans/GDP, CA/GDP, and Capital inflows are sourced from the CBRT, and VIX is the period average. Four-quarter moving averages are plotted.

period, while the largest ten banks' shares are between 80 to 90 percent.

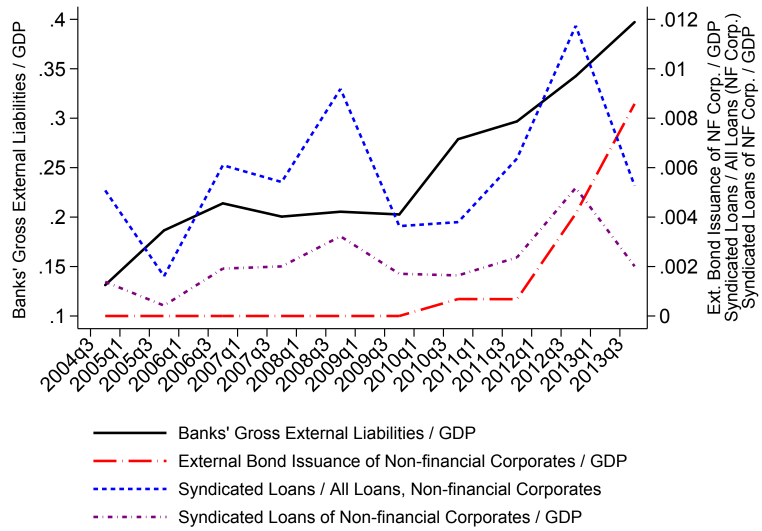
Our baseline analysis uses quarterly bank balance sheet data from Turkey for the 2003–2013 period. The data are collected at the monthly level, and we use March, June, September, and December reports. All banks operating within Turkey are required to report their balance sheets as well as extra items to the regulatory and supervisory authorities – such as the CBRT and the Banking Regulation and Supervision Agency (BRSA) – by the end of the month.

Over the 2003–13 period there are 47 banks, of which 28 are commercial, 14 are investment and development, and 5 are branches of foreign banks.[15] Our sample of banks varies between 35 and 45 throughout the period since we focus on banks that are active in the corporate loan market and this number changes from period to period.[16] Table A6 presents summary statistics for our final sample of banks, based on end-of-quarter data pooled over the sample period. These variables, like others used in the paper, are winsorized at the one-percent level. There is quite a bit of variation in bank size, as measured by total assets as noted above. Similarly, there is variation in the capital ratio, the non-core ratio, liquidity, and return on assets (ROA) across banks and over time.

[15]Note that in the aftermath of the 2001 crisis, the weak capital structure of the Turkish banks resulted in a number of takeovers. As a result, in 2000–2004 period, a total of 25 banks were taken over by Deposit-Insurance Fund, SDIF. Our sample begins at the end of this period, where the majority of takeovers were completed.

[16]We also drop four participation banks that make up only a very small fraction of the loan market.

Figure 3. Banks and Firms External Borrowing, 2005–13



Notes: This figure plots the external liabilities of banks and external corporate bond issuance as a ratio to GDP. Source: CBRT.

3.3 Macro-Level Data

Figure 2 plots Turkey's credit growth (Loans/GDP Growth) and current account position (CA/GDP) against log(VIX) and Turkish capital inflows on top and bottom panels respectively. Movements in the VIX tend to be negatively correlated with Turkey's credit growth, and positively correlated with the current account balance (a fall in the current account implies an *increase* in net capital inflows). Loan-to-GDP growth fluctuates between 5 to 10 percent quarterly during our sample. Looking at a more direct measure of capital flows to Turkey, we see that this measure is positively correlated to Turkey's credit growth, while negatively correlated with its current account. These correlations are consistent with the story as described for VIX in introduction.

Firms' direct external borrowing is very limited in Turkey and hence banks are the key intermediary of capital flows. As Figure 3 shows, the external corporate bond issuance is negligible as a percentage of GDP, whereas banks' external borrowing is as high as 40 percent of GDP at the end of our sample period.

Table A7 presents summary statistics for the quarterly Turkish and global macroeconomic and financial variables that we use as controls in our regressions, as well as measures of global financial conditions. All real variables are deflated using 2003 as the base year. The Turkish macroeconomic data are taken from the CBRT. VIX and the Turkish overnight rate are quarterly averages. There is substantial quarterly variation in all these variables, over the sample period, which is crucial for our identification strategy.

Our choice of using the overnight (O/N) rate for the policy rate reflects the change in the definition of the policy rate and the monetary policy framework during our sample. The official policy rate is either the O/N borrowing rate of the CBRT (before 2010) or the CBRT 1-week repo rate (after 2010) where CBRT lends to banks through weekly repo. While central banks implement the monetary policy via a single policy rate, the CBRT deviated from this standard policy by using an asymmetric and wide interest rate corridor since 2010 in order to incorporate financial stability into the monetary policy framework. The upper bound of the corridor is the CBRT O/N lending rate to banks and the lower bound is CBRT borrowing rate. The CBRT provided liquidity mainly through two distinct channels (i.e., the O/N lending and 1-week repo lending rates) and hence at two different interest rates since 2010, during a period where the CBRT acted as a net lender. The CBRT announces the amount of funds allocated for weekly repo and distributes them among bidding banks in proportion to their size. When only part of the liquidity is provided through weekly repo, banks have to borrow overnight at the O/N lending rate for their remaining liquidity needs. By using the O/N lending rate as the policy rate, we are therefore using the upper bound for the cost of borrowing from the CBRT for banks.

Inflation expectations data are from the "Survey of Expectations," which has been conducted by the Central Bank of the Republic of Turkey (CBRT) monthly since August 2001. It is the most widely followed survey by the CBRT and financial market participants on expectations about key macroeconomic variables in Turkey. The survey is sent to approximately 120 forecasters from the financial and real sectors and academia, and asks for their consumer price inflation expectations at various horizons (current month, end of year, 12-months ahead and 24-month ahead) as well as their expectations about interest rates, the current account balance and GDP growth rate. We use the 12-months ahead expectation to construct the real interest rate. Using model-predicted inflation expectations based on an AR(1) process on year-on-year inflation rather than using actual survey data on inflation expectations at the annual frequency yields similar results. Exchange rate expectations are based on data from a survey of forecasters of the one-year ahead expected Turkish lira-U.S. dollar, which are collected at the monthly frequency. The expected quarterly (t to $t+1$) exchange rate change viz. the US dollar is calculated by taking the difference of the quarterly average of the monthly expectations. These data only exist from 2006Q4 to 2013Q4.

4 Transmission of the GFC to the Domestic Credit Market

4.1 Macro Capital Inflows Regressions: OLS

We begin with "macro" regressions, which regress the nominal interest rate ('i') and the loan principal outstanding ('Loan') on Turkish capital inflows in OLS and IV instrumenting capital inflows with VIX. Regressions are weighted-least squares, where weights are the natural logarithm of the loan value. The standard errors are double clustered at the firm and time levels.[17] We run:

$$\begin{aligned}\log \mathrm{Y}_{f,b,d,q} = \alpha_{f,b} + \lambda \mathrm{Trend}_q + \beta \log \mathrm{Capital\ inflows}_{q-1} + \delta \mathrm{FX}_{f,b,d,q} + \Theta_1 i_{q-1} \\ + \Theta_2 \Delta \log(\mathrm{GDP}_{q-1}) + \Theta_3 \mathrm{Inflation}_{q-1} + \Theta_4 \mathbf{Bank}_{b,q-1} + \varepsilon_{f,b,d,q},\end{aligned} \tag{5}$$

where $\mathrm{Y}_{f,b,d,q}$ is either $\mathrm{Loans}_{f,b,d,q}$ or one plus the nominal interest rate $(1 + i_{f,b,d,q})$, for a given firm-bank (f, b) pair in a given currency denomination (d) and quarter (q). 'Capital inflows' is gross Turkish capital inflows in 2003 Turkish liras. Further, $\alpha_{f,b}$ is a firm×bank fixed effect, which controls for unobserved firm and bank level time-invariant heterogeneity; Trend_q is a linear trend variable to make sure the data are stationary. FX is a dummy variable that is equal to 1 if the loan is in foreign currency, and 0 if it is in Turkish lira.

As we show above, in our framework, firm-bank level interest rates will be a function of the domestic policy rates (i_{q-1}) plus the firm risk premium, where domestic policy rates equal to sum of foreign interest rate, expected exchange rate changes, and country fundamentals/risk, proxied by GDP growth and inflation. Since we show that this equation does not hold and the residuals from this equation is largely explained by the GFC, we include capital inflows in addition to domestic policy rates to account for the residuals, that is the UIP risk premium. We include the domestic policy rate directly, since it includes information aside from the UIP condition. We therefore include the UIP determinants in another specification. That is, we drop the domestic rate and include directly the foreign interest rate, (i^*_{q-1}), and expected exchange rate changes, ($\mathbb{E}_{q-1}\Delta e_q$).[18] We control for macro fundamentals in every specification.

We also add under "**Bank**" a set of bank characteristics that control for bank heterogeneity,

[17] Petersen (2009) shows that the best practice is to cluster at both levels, or if the number of clusters is small in one dimension, then use a fixed effect for that dimension and cluster on the other dimension, where more clusters are available.

[18] Notice that we only control non-time-varying firm risk via firm fixed effects, α_f whereas our framework requires to control time-varying firm risk, $\alpha_{f,t}$. We add *firm*×*year* effects for this to the specification above, which capture the time-varying unobserved heterogeneity for firms from year to year, while still allowing us to estimate the impact of capital inflows and other variables at the quarterly level. When we run difference-in-differences regressions below, we will control time-varying firm risk also at the quarterly level by adding firm×quarter effects.

including log(assets), capital ratio, liquidity ratio, non-core liabilities ratio, and return on total assets (ROA). These variables are standard in the literature and importantly include the inverse of banks' leverage (i.e., the capital ratio), which has been highlighted as responding to global financial conditions and wealth effects arising from exchange rate and asset price changes (e.g., Bruno and Shin, 2015a,b), thus allowing banks to expand their lending. We lag all the controls.

Table 1 presents the results for the capital inflows regressions (5) for nominal interest rates and loan volumes.[19] Given the inclusion of the firm×bank fixed effects, we use the within firm-bank variation over the sample period to estimate the coefficients of interest. Hence, we only identify from quarterly changes in aggregate loans at the firm-bank level and their average interest rates as a function of quarterly changes in capital flows for a given firm-bank pair, relative to another pair. This strategy addresses potential time-invariant selection effects due to different types of bank and firm relationships, as well as controls for time-invariant firm and bank characteristics.

Panel A presents the OLS estimates for the nominal interest rate, and panel B for the loan volumes. Across all columns, capital inflows to Turkey are associated with lower interest rates and higher loan volumes. Furthermore, the coefficient on the FX dummy shows that loans denominated in foreign currency have lower interest rates on average relative to TL loans and are larger in value (twice the size of TL loans). The price differential between FX and TL loans is very large, where FX loans are 7 percentage points cheaper on average, also in real terms given the fact that inflation is controlled. This differential captures the average UIP risk premium and controlling for the actual (column 1) or the expected exchange rate changes (column 2) do not overturn this large differential. The interest rate differential between borrowing in two currencies remains equally high if we do not control for actual or expected exchange rates.[20] GDP growth and inflation also play no role on the price differential of TL versus FX loans, which may not be surprising given that the regression control for the domestic policy rate, either directly (column 1) or via its UIP-implied determinants, the foreign rate (US Fed Funds rate) and expected exchange rate changes (column 2).

The domestic policy rate (column 1) and foreign policy rate (column 2) have positive effects on firm-bank level interest rates, though the US Fed Funds rate is not significant. The domestic rate is insignificant in the loan volumes regression (column 3), while the foreign rate is significant but positive (column 4), implying a tighter monetary policy in the US is associated with more credit growth in Turkey or vice versa. Given that we control for capital flows directly, this positive

[19]Note that in these and other tables, we lose 15 time series observations (out of 44) when including the expected exchange rate change given lack of data for this series at the beginning of the sample period.

[20]The TL-FX differential is close to 8 percentage point in these regressions, which are available upon request.

Table 1. Impact of GFC on Borrowing Costs and Loan Volumes: OLS

	Panel A. Nominal Interest Rate		**Panel B.** Loan Volume	
	(1)	(2)	(3)	(4)
log(K Inflows)	-0.005^{a}	-0.003^{c}	0.040^{a}	0.037^{a}
	(0.001)	(0.002)	(0.006)	(0.007)
FX	-0.070^{a}	-0.066^{a}	0.645^{a}	0.638^{a}
	(0.003)	(0.003)	(0.012)	(0.013)
Domestic policy rate	0.231^{a}		-0.078	
	(0.022)		(0.262)	
GDP growth	-0.043	-0.198^{a}	-0.135	0.523
	(0.033)	(0.065)	(0.269)	(0.435)
Inflation	-0.010	-0.003	0.021	0.042
	(0.011)	(0.018)	(0.108)	(0.083)
XR change	-0.023^{b}		0.051	
	(0.010)		(0.100)	
Expected XR change		-0.045		0.546^{b}
		(0.034)		(0.253)
Foreign rate (US FFR)		0.084		3.245^{a}
		(0.128)		(1.120)
Observations	19,982,267	18,569,346	19,982,267	18,569,346
R-squared	0.791	0.810	0.850	0.855
Macro controls & trend	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes
Bank×firm F.E.	Yes	Yes	Yes	Yes

Notes: This table presents results for the OLS regressions for (5) using quarterly data for all loans. Columns (1) and (2) in Panel A use the natural logarithm of one plus the weighted-average of nominal interest rates for loans between a firm-bank as the dependent variable. Columns (3) and (4) in Panel B use the natural logarithm of total loans between a firm-bank as the dependent variable. The 'K Inflows' variable is one-quarter lagged real quarterly gross capital inflows into Turkey, FX is a 0/1 dummy indicating whether a loan is in foreign currency (= 1) or domestic (= 0), the domestic rate is the lagged quarterly average overnight rate, GDP growth is lagged real quarterly GDP growth, inflation is lagged quarterly CPI changes, XR change is the lagged quarterly Turkish lira/US dollar exchange rate change, the expected exchange rate change is based on monthly survey data for the Turkish lira/US exchange dollar rate and is lagged, and the foreign rate is the lagged US Fed Funds rate. A linear time trend is also included as a regressor. Furthermore, the lagged values of the following bank-level characteristics are also controlled for (not reported): log(assets), capital ratio, liquidity ratio, non-core liabilities ratio, and return on total assets (ROA). Regressions are all weighted-least square, where weights are equal to the loan share, and standard errors are double clustered at the firm and quarter levels. 'a' indicates significance at the 1% level, 'b' at the 5% level, and 'c' at the 10% level.

relationship between US rates and loan volumes in column (4) may also in part be driven by the counter-cyclical nature of monetary policy (e.g., US interest rates were low during the crisis when credit contracted worldwide, including in Turkey).

4.2 Macro Capital Inflows Regressions: IV

We next run an IV regression, instrumenting capital inflows with our proxy for the GFC, VIX. Table 2 presents these results. First, focusing on the bottom part of the table, we see that the first-stage regression is strong, showing a significant negative effect of VIX on capital inflows in our baseline specifications in columns (1) and (3),[21] and a F-statistic of 15.2, which is larger than the rule-of-thumb value of Staiger and Stock (1997); Stock et al. (2002), indicating that the weak instrument problem is not a concern. Turning to columns (2) and (4), which use the expected exchange rate and the US Fed Funds rate as controls, we also find a significant negative effect of VIX on capital inflows. The F-statistic is slightly less than 10 (9.1). It should be noted that the use of the expected exchange rate data cuts the time series dimension from 44 to 29 observations, which helps explain the lower F-stat. We have also run the specification using the actual rather than expected rate, and find similar results with an F-statistic greater than 10 (12.6) and the coefficient on log(VIX) of -1.466.[22]

The top part of the table reports the second-stage results, which show that exogenous supply-side driven capital inflows have a strong negative effect on borrowing costs and a positive effect on loan volumes as in the OLS regressions. The FX price differential stays the same as the effect of all other variables relative to the OLS results.

To further separate the effect of demand- and supply-driven capital inflows, we exploit the differential impact of the two types of capital inflows on domestic borrowing rates to derive a predictable hypothesis. Figure 4 presents two figures plotting out comparative statics arising from different sets of shocks. Figure 4a shows what happens for purely supply-driven changes in credit. In this case, the net effect on loan volumes will be positive, along with an unambiguous fall in borrowing costs, as the economy moves along the demand curve from point A to point B. Figure 4b considers an increase in the supply of lending, along with several different possible demand shocks. First, assume that the increase in demand (D_0 to D_1) is greater than the increase in supply (S_0 to S_1), which implies that while credit volume increases, the interest rate also rises (point B:

[21] Note that we report the same first-stage regressions for the interest rate and loan volume for completeness.

[22] Actual and expected exchange rate changes are highly correlated in the data, with a correlation coefficient of 0.887.

Table 2. Impact of GFC on Borrowing Costs and Loan Volumes: IV

Second-stage of IV

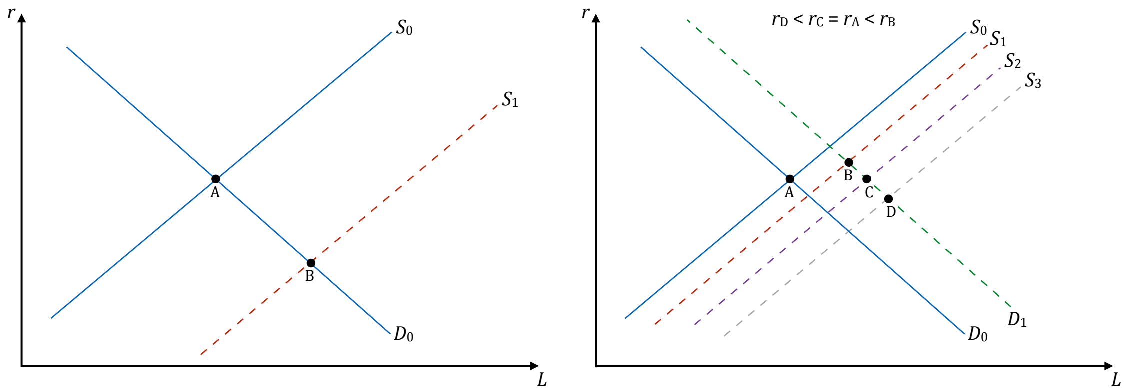
	Panel A. Nominal Interest Rate		Panel B. Loan Volume	
	(1)	(2)	(3)	(4)
log(K Inflows)	-0.011^a	-0.014^a	0.039^b	0.047^b
	(0.002)	(0.002)	(0.017)	(0.020)
FX	-0.070^a	-0.066^a	0.644^a	0.638^a
	(0.003)	(0.003)	(0.012)	(0.013)
Domestic policy rate	0.213^a		-0.014	
	(0.025)		(0.346)	
GDP growth	-0.024	-0.171	0.022	0.580
	(0.035)	(0.062)	(0.336)	(0.448)
Inflation	-0.011	0.011	0.075	0.039
	(0.016)	(0.009)	(0.143)	(0.099)
XR change	-0.046^a		0.047	
	(0.010)		(0.125)	
Expected XR change		-0.115^a		0.590^b
		(0.026)		(0.287)
Foreign rate (US FFR)		0.560^a		2.337
		(0.120)		(1.574)
Observations	19,437,464	18,569,346	19,437,464	18,569,346
R-squared	0.793	0.812	0.850	0.855
Macro controls & trend	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes
Bank×firm F.E.	Yes	Yes	Yes	Yes

First-stage of IV

	Dependent variable: log(K inflows)			
	(1)	(2)	(3)	(4)
log(VIX)	-1.667^a	-1.354^a	-1.667^a	-1.354^a
	(0.427)	(0.450)	(0.427)	(0.450)
Observations	1,685	1,137	1,685	1,137
R-squared	0.562	0.557	0.562	0.557
Macro controls & trend	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes
F-stat	15.2	9.1	15.2	9.1

Notes: This table presents results for the IV regressions for (5) using quarterly data for all loans. Columns (1) and (2) in Panel A use the natural logarithm of one plus the weighted-average of nominal interest rates for loans between a firm-bank as the dependent variable. Columns (3) and (4) in Panel B use the natural logarithm of total loans between a firm-bank as the dependent variable. The 'K Inflows' variable is tje one-quarter lagged real quarterly gross capital inflows into Turkey. K Inflows is instrument by VIX in columns (1)-(4). The FX, macroeconomic, banking and trend variables are all included and defined as in Table 1. Second-stage regressions are all weighted-least square, where weights are equal to the loan share, and standard errors are double clustered at the firm and quarter levels. The first-stage regression for the IV, which is run at the bank×quarter level for the whole sample period when using the actual exchange rate, and for the 2006Q3–2013Q4 period when using the exchange rate expectations data. The regression includes all time-varying controls appearing in the second stage, as well as bank fixed effects, and standard errors are double clustered at the bank and quarter levels. 'a' indicates significance at the 1% level, 'b' at the 5% level, and 'c' at the 10% level.

Figure 4. Supply and Demand Shocks to Credit Market: Relative Impacts



(a) Supply shock

(b) Supply and Demand shocks

$r_{\mathrm{B}} > r_{\mathrm{A}}$). Second, demand and supply are assumed to increase symmetrically (i.e., S_0 to S_2), so that new equilibrium is now at point C. Here, loan volumes increase even more relative to the initial equilibrium at point A, while the interest rate remains the same as in the initial equilibrium (i.e., $r_{\mathrm{C}} = r_{\mathrm{A}}$). Finally, the increase in supply to S_3 is greater than the shock to the demand for loans, so that the interest rate now falls relative to the pre-shock equilibrium ($r_{\mathrm{D}} < r_{\mathrm{A}}$). Again, the loan volume increases.

To be able to make use of this framework, where demand and supply shocks will have opposing effects on the interest rate, one needs to instrument capital inflows to isolate these shocks. Since we do this by using VIX as an instrument, we can compare the OLS and IV estimates for the interest rate regressions in columns (1) and (2) of table Table 2 to their counterparts in Table 1. Comparing the estimated IV and OLS elasticities for the nominal interest rate we see that $|\beta^{IV}| > |\beta^{OLS}|$, which points to VIX-driven capital inflows capturing a supply-side effect. To quantify the difference in the OLS and IV estimates, we calculate the effect of an increase in the log of capital inflows equivalent to its interquartile range. The OLS estimate implies that the average cost of borrowing will fall by 0.36 percentage point, while the IV estimate implies a drop of 0.80 percentage points as a response to such an increase in capital inflows.

This downward bias in the absolute value of the estimated OLS coefficient for the interest rate is what one would expect to find since an increase in the demand for loans puts upward pressure on the interest rate, and if this demand also corresponds to increased demand for foreign capital, the estimated relationship between capital inflows and lending rates would be attenuated.

Therefore, by using VIX to isolate the supply effect, the IV estimates deliver a larger negative relationship between capital inflows and interest rates, since now demand effects are parsed out from the estimated coefficients.

4.3 Macro Reduced-Form VIX Regressions

Having established VIX as a valid instrument, we further examine the impact of VIX directly in a reduced-form setting, by running a regression analogous to (5), but replacing capital inflows with VIX directly:

$$\begin{aligned}\log \mathrm{Y}_{f,b,d,q} = \widetilde{\alpha}_{f,b} + \widetilde{\lambda}\mathrm{Trend}_q + \widetilde{\beta}\log \mathrm{VIX}_{q-1} + \widetilde{\delta}\mathrm{FX}_{f,b,d,q} + \widetilde{\Theta}_1 i_{q-1} + \widetilde{\Theta}_2 \Delta \log(\mathrm{GDP}_{q-1}) \\ + \widetilde{\Theta}_3 \mathrm{Inflation}_{q-1} + \widetilde{\Theta}_4 \mathbf{Bank}_{b,q-1} + \widetilde{\varepsilon}_{f,b,d,q}.\end{aligned} \tag{6}$$

This reduced-form approach not only provides a direct estimate of the elasticity of credit conditions in Turkey vis-à-vis VIX (i.e., $\widetilde{\beta}$), but it also sets a benchmark for the heterogeneity regressions below, where we interact VIX with different loan, firm, and bank characteristics, thus avoiding the need for a two-stage approach in exploring heterogeneity.

Table 3 presents the reduced-form results. Both interest rate and loan volume regressions deliver similar results as the capital inflow regressions, and are economically significant. The estimated coefficient for the effect of VIX on the interest rate (0.019) implies a 1 percentage point fall in the average borrowing rate resulting from a fall in log(VIX) equal to its interquartile range over the sample period. The baseline micro estimates of the elasticity of domestic loan growth with respect to changes in VIX is -0.067. We use this estimated VIX coefficient to quantify the effect of movements in VIX on aggregate credit growth. Appendix B.2 provides an aggregation equation, which shows how to use the micro estimates to draw implications for *aggregate* credit growth over the cycle. We can explain on average 43 percent of observed cyclical *aggregate* loan growth to the corporate sector.[23]

We run several robustness tests on these results. We used different bank samples, such as commercial and state banks, or domestic vs. foreign banks. The elasticity of the real interest rate with respect to VIX for domestic banks is more than double that of foreign banks, and is strongly significant. This result shows the relative importance of domestic banks in transmitting the global

[23] We apply (B.5) using $\widehat{\widetilde{\beta}} = -0.067$ and the observed change in log(VIX) to obtain predicted aggregate loan growth. We then divide this series by the linearly detrended series of *actual* aggregate credit growth, and take the average of this ratio to arrive at 43 percent.

Table 3. Impact of GFC on Borrowing Costs and Loan Volumes: Reduced Form

	Panel A. Nominal Interest Rate (1)	(2)	**Panel B.** Loan Volume (3)	(4)
log(VIX)	0.019^a	0.020^a	-0.067^b	-0.069^b
	(0.003)	(0.003)	(0.029)	(0.029)
FX	-0.070^a	-0.066^a	0.645^a	0.638^a
	(0.003)	(0.003)	(0.012)	(0.013)
Domestic policy rate	0.204^a		0.127	
	(0.024)		(0.323)	
GDP growth	-0.061^c	-0.183^a	0.175	0.620
	(0.033)	(0.061)	(0.311)	(0.438)
Inflation	-0.013	-0.002	0.046	0.085
	(0.015)	(0.009)	(0.125)	(0.104)
XR change	-0.045^a		0.049	
	(0.009)		(0.126)	
Expected XR change		-0.0771^a		0.465
		(0.024)		(0.269)
Foreign rate (US FFR)		0.331^a		3.095^b
		(0.104)		(1.371)
Observations	19,982,267	18,569,346	19,982,267	18,569,346
R-squared	0.793	0.812	0.85	0.855
Macro controls & trend	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes
Bank×firm F.E.	Yes	Yes	Yes	Yes

Notes: This table presents results for the OLS regressions for (6) using quarterly data for all loans. Columns (1) and (2) in Panel A use the natural logarithm of one plus the weighted-average of nominal interest rates for loans between a firm-bank as the dependent variable. Columns (3) and (4) in Panel B use the natural logarithm of total loans between a firm-bank as the dependent variable. VIX is the lagged quarterly average. The FX, macroeconomic, banking and trend variables are all included and defined as in Table 1. Regressions are all weighted-least square, where weights are equal to the loan share, and standard errors are double clustered at the firm and quarter levels. 'a' indicates significance at the 1% level, 'b' at the 5% level, and 'c' at the 10% level.

financial cycle to the Turkish domestic credit market. We also use only a sub-component of VIX that represents risk aversion, which is computed following Bekaert et al. (2013).[24] We further include only firms that borrow from multiple banks; and split the sample by maturity of loans, as well as pre-/post-crisis periods. Results are robust to all checks – see Appendix B.3 and Table A8.

4.4 The Role of Domestic Banks' Exposure to International Markets in the GFC Transmission

To further identify the spillovers from global financing conditions into the domestic credit market via supply-driven capital inflows, we explore variation in banks' exposure to international financial markets and how this exposure affects *pricing* of loans, fully accounting for firm time-varying characteristics and demand for credit. To focus on how the difference in banks reliance on financing via non-traditional (or wholesale) funding impacts their behavior over the global financial cycle, we use banks' non-core liabilities (Hahm et al., 2013).[25] We construct a 'NonCore' ratio, which is non-core liabilities divided by total liabilities.[26] We estimate:

$$\log \mathrm{Y}_{f,b,d,q} = \alpha_{f,b} + \alpha_{f,q} + \zeta(\mathrm{NonCore}_b \times \log \mathrm{VIX}_{q-1}) + \delta_1 \mathrm{FX}_{f,b,d,q} + \epsilon_{f,b,d,q}, \tag{7}$$

where $\alpha_{f,q}$ is a firm×quarter fixed effect, controlling for firms' credit demand. '$\mathrm{NonCore}_b$' is a time-invariant dummy variable, for whether a bank has a high non-core liabilities ratio or not, where a bank is assigned a 1 for "high" if its average non-core ratio over time is larger than the median of all banks' non-core over the sample; otherwise, it receives a zero for a "low" non-core bank.[27]

Table 4 shows that banks with higher non-core liabilities respond more to movements in VIX in their loan pricing and also in loan issuances. During periods of low VIX, high non-core banks decrease their borrowing rates more. The estimated coefficient on the interaction between VIX and the non-core dummy is 0.013 when including firm×quarter effects in column (2), which is almost as large as the estimated elasticity of 0.019 between the interest rate and VIX in the macro regression of Table 3. Therefore, the relative differential in changes in interest rates for high non-core banks

[24] We would like to thank Marie Horoeva for providing us with an updated series.

[25] Baskaya et al. (2017) study the differential impact of capital inflows on credit supply for large and high non-core banks vis-à-vis small/low non-core ones. They did not investigate the impact of this heterogeneity on pricing of loans, a task we undertake here.

[26] NonCore liabilities = Payables to money market + Payables to securities + Payables to banks + Funds from Repo + Securities issued (net).

[27] We have also run regressions allowing for the slope on the trend variable to be heterogeneous across groups and results are robust.

Table 4. GFC and Banks' Funding Markets

	Panel A. Nominal Interest Rate		**Panel B.** Loan Volume	
	(1)	(2)	(3)	(4)
log(VIX)	0.015^a		-0.051^c	
	(0.003)		(0.028)	
FX	-0.070^a	-0.070^a	0.645^a	0.690^a
	(0.003)	(0.003)	(0.012)	(0.013)
NonCore×log(VIX)	0.015^a	0.013^a	-0.058^a	-0.035^b
	(0.004)	(0.003)	(0.016)	(0.017)
Observations	19,982,267	9,280,825	19,982,267	9,280,825
R-squared	0.794	0.858	0.850	0.876
Macro controls & trend	Yes	No	Yes	No
Bank controls	Yes	No	Yes	No
Bank×firm F.E.	Yes	Yes	Yes	Yes
Firm×quarter F.E.	No	Yes	No	Yes

Notes: This table presents results for the OLS regressions for (7) using quarterly data for all loans. Columns (1) and (2) in Panel A use the natural logarithm of one plus the weighted-average of nominal interest rates for loans between a firm-bank as the dependent variable. Columns (3) and (4) in Panel B use the natural logarithm of total loans between a firm-bank as the dependent variable. VIX is the lagged quarterly average, FX is a 0/1 dummy indicating whether a loan is in foreign currency (= 1) or domestic (= 0), and Noncore_b is a 0/1 dummy variable indicating whether a bank has a high (= 1) or low (= 0) non-core liabilities ratio. All macroeconomic, banking and trend variables are included and defined as in Table 1. Regressions are all weighted-least square, where weights are equal to the loan share, and standard errors are double clustered at the firm and quarter levels. 'a' indicates significance at the 1% level, 'b' at the 5% level, and 'c' at the 10% level.

given movement in global uncertainty is economically large, and high non-core banks are responsible for a significant part of the aggregate effect.

We further run the interaction regression including VIX on its own without firm×quarter effect in order to recover the VIX-only coefficient in column (1). In this case, the estimated coefficient on VIX is slightly lower (0.015) than the one in the macro regressions, while the coefficient on the interaction between the non-core dummy and VIX is almost the same (0.015) as in the regression with firm×quarter effects. Given this regression, the estimated interest rate-VIX elasticity for high non-core banks is double $(0.015 + 0.015 = 0.03)$ that of low non-core banks (0.015). We can use the estimated coefficients for the loan volume regressions and the aggregation accounting exercise as described in Appendix B.2 to gauge the importance of high non-core banks in explaining aggregate credit growth over the sample period. Specifically, we take the ratio of the calculated average aggregate loan growth using the coefficients for VIX and the interacted non-core coefficient for high non-core banks to the average aggregate loan growth calculated for all banks, and find this ratio to be 0.95.[28] The role of bank heterogeneity in driving *aggregate* credit market conditions has recently been shown to be important in the closed-economy literature by Coimbra and Rey (2017). Their model emphasizes that heterogeneity in bank leverage can create systemic risk when there is a funding cost shock to banks. Our result points to a new source of heterogeneity to consider for open-economy models.

To summarize, internationally exposed banks (as proxied by the high levels of non-core liability ratio) plays a dominant role in explaining our overall aggregate results. This result combined with the fact that we are able to control for time-varying firm characteristics and firms' credit demand in these specifications gives us further confidence that the macro regressions above are capturing the causal impact of GFC-driven capital inflows on the domestic credit market.

5 Transmission Channels

5.1 FX and Local Currency Loan Pricing

We have shown that FX loans have a large price differential over local currency loans, where the size of this price differential is 7 percentage points on average. We next ask whether this price differential also moves with the GFC. As Figure 1 shows, in the aggregate data, the UIP risk premium moves in tandem with the GFC, proxied by VIX. During high VIX episodes, the premium increases and during low VIX periods the premium decreases. Recall that we have calculated this premium as the residual (ϵ_t) from running the standard UIP regression between Turkey and the US: $i_t - i_t^* = \alpha + \lambda_t + \beta \mathbb{E}_t \Delta e_{TL/USD,t+1} + \epsilon_t$, where i denotes the (annualized) Turkish interest rate and is calculated as the loan value weighted average of all Turkish lira (TL) loans outstanding in a given quarter t. In this section, we check if this relation also holds in a difference-in-differences regression setting at the micro level where the loan interest rate differential between FX and local currency loans co-move with VIX, while controlling for aggregate and micro determinants of these loan rates. We run for regressions at the firm-bank-denomination-quarter level for interest rates:

$$\log(1 + i_{f,b,d,q}) = \alpha_{f,b,q} + \rho(\mathrm{FX}_{f,b,d,q} \times \log \mathrm{VIX}_{q-1}) + \delta \mathrm{FX}_{f,b,d,q} + u_{f,b,d,q}, \tag{8}$$

[28] This number drops to approximately 0.86 if we use the (smaller) sample that contains only multiple firm-bank observations, as in column (4) of Table 4.

where we exploit the currency composition of loans (d) within a firm-bank pair, which allows us to control for time-varying fixed effects at the firm and bank level ($\alpha_{f,b,q}$).

Table 5. Impact of GFC on the UIP Risk Premium at the Firm-Bank Level

	(1)	(2)	(3)	(4)
log(VIX)	0.020[a]			
	(0.003)			
FX	-0.070[a]	-0.070[a]	-0.070[a]	-0.070[a]
	(0.003)	(0.003)	(0.003)	(0.003)
FX×log(VIX)	-0.013[a]	-0.013[b]	-0.012[b]	-0.012[c]
	(0.004)	(0.006)	(0.006)	(0.007)
Observations	19,982,267	9,280,825	9,280,757	888,972
R-squared	0.793	0.858	0.884	0.731
Macro controls & trend	Yes	No	No	No
Bank controls	Yes	Yes	No	No
Bank×firm F.E.	Yes	Yes	Yes	No
Bank×quarter F.E.	No	No	Yes	No
Firm×quarter F.E.	No	Yes	Yes	No
Bank×Firm×quarter F.E.	No	No	No	Yes

Notes: This table presents results for the OLS regressions for (8) using quarterly data for all loans. Columns (1) through (4) use the natural logarithm of one plus the weighted-average of nominal interest rates for loans between a firm-bank as the dependent variable, and include different variations of fixed effects. VIX is the lagged quarterly average. The FX, macroeconomic, banking and trend variables are all included and defined as in Table 1. Regressions are all weighted-least square, where weights are equal to the loan share, and standard errors are double clustered at the firm and quarter levels. 'a' indicates significance at the 1% level, 'b' at the 5% level, and 'c' at the 10% level.

Table 5 presents the results for these regressions, where we include the fixed effects in order from column (1) to column (4): firm×bank, firm×quarter, bank×quarter, and then finally firm×bank×quarter. In all the specifications, the average price differential between FX and local currency loans remains at 7 percentage point. More interestingly, during high VIX episodes, this differential gets larger, where FX loans are 8 percentage points cheaper during high VIX episodes, whereas they are only 6 percentage point cheaper during low VIX episodes. This result implies that local currency borrowing becomes *relatively* cheaper during low VIX episodes relative to the average differential between FX and local currency loans.

It is noteworthy that the cyclical nature of the UIP risk premium at the micro level is robust to controlling firm×bank×quarter fixed effects, since these fixed effects control for all the firm-bank-time-varying determinants of the loan rate differential between FX and local currency loans, such as time-varying firm credit risk, and also relies on a much smaller sample of observations. This is important since there are several demand factors that might underlie the price differential, such as high demand from exporters for FX loans during low VIX episodes. This result is novel and is in line with our theoretical framework where the differential between FX and TL rates goes down as a result of a decrease in country risk premium, regardless of firm-bank factors, which is triggered by a fall in VIX.

In terms of quantities, we do not find any significant differential between FX and TL loans.[29] Recall that in our benchmark regressions we find that FX loans are larger in value in normal times. Here we find that during a given period of low VIX both TL and FX loans' value increase at the same rate for observed firm-bank relationships relative to their mean value over the sample. The interest rate regressions above reveal that the cost of TL borrowing fell more relative to average so if this encourages entry of new firms who prefer to borrow in TL when VIX falls,[30] aggregate loan growth will increase.

5.2 Loan-Level Financial Constraints

We estimate a loan-level version of our previous estimation regressions using monthly data on loan originations. Besides allowing us to control for time-varying heterogeneity at the bank and firm levels, moving to loan-level data also helps us in terms of using a better variable for firms' collateral/credit risk. Specifically, rather than proxying for financial constraints by a firm's net worth as is common in the literature,[31]. we can use the actual collateral pledged for a loan at its issuance, and measure whether its effect on loan pricing and volume moves with VIX. This measure on pledged collateral also helps us to link our results to the theoretical literature on firm heterogeneity and collateral constraints.

The regression specification is;

$$\begin{aligned}\log \mathrm{Y}_{f,b,l,m} = \varrho_{f,b,m} &+ \beta_1 \mathrm{Collateral}_{f,b,l,m} + \beta_2(\mathrm{Collateral}_{f,b,l,m} \times \log \mathrm{VIX}_{m-1}) \\ &+ \beta_3 \mathrm{FX}_{f,b,l,m} + e_{f,b,l,m},\end{aligned} \tag{9}$$

where we change the q subscript to m for variables that vary at a monthly level, and focus on both loan volume and the interest rate as the endogenous variables for a given loan l. $\mathrm{Collateral}_{f,b,l,m}$

[29] These results are not shown but available upon request.

[30] Recall from Table A3 that the majority of firms borrow in TL. Further, there is a five-fold increase in the loan-to-GDP ratio during our sample period. This is driven by a six-fold increase in domestic currency loans and a three-fold increase in FX loans, both as a ratio to GDP.

[31] Cooley et al. (2004); Cagetti and De Nardi (2006); Khan and Thomas (2013); Virgiliu and Xu (2014); Gopinath et al. (2017)

measures the collateral-to-loan ratio at the initiation of the loan, and $\varrho_{f,b,m}$ is a firm×bank×month effect that captures time-varying firm and bank level unobserved factors at the monthly level. Notice that with these fixed effects, we solely identify from changes in the amount of new loans and their interest rates for a given firm-bank pair. Hence, in our most stringent specification we do not allow firms to switch banks and vice versa for banks. This helps assuage the concern of biased results due to time-varying selection effects at the firm-bank level. Since we use data on *new* loan issuances to run these regressions, we only see each loan once and thus exploit changes in rates and volume of each new loan from month to month to identify the impact of loan riskiness/collateral, conditional on all other time-varying firm and bank factors.[32]

Table 6 presents our main results, where we first demean both the collateral ratio and log(VIX) before running the regressions. As shown in panel A, the collateral ratio coefficient is significant and has the expected negative sign in all columns; that is, there is a negative relationship between the collateral ratio and the price of a loan. However, this relationship does not move together with VIX once we control for the unobserved time-varying firm demand in columns (3)-(4), which control for firm×month fixed effects. In panel B, there is a strong positive effect of the collateral-to-loan on loan volumes in all columns, indicating collateral constraints exist at the loan level and are independent of firm-bank-time varying factors. Importantly, this relation moves with VIX, although weakly, in all columns: that is the loan level collateral constraints strengthens with high VIX and relaxes with low VIX. In terms of the magnitudes, though, this cyclical effect is not large.[33] Taking the estimates in column (4), at the mean value of the VIX, the total effect of the collateral ratio on the loan amount is 0.091. This coefficient implies that an increase in the collateral ratio for new loans that is equivalent to its interquartile range of 0.95, increases the new loan amont by 8.6 percentage points.

To quantify the relative impact of collateral constraints in periods of low VIX, we take the derivative of (9) with respect to the collateral ratio, and evaluate it at the minimum value of log(VIX).[34] This yields a total effect of the collateral ratio on the new loan amount of 0.074 based

[32]Note that the collateral-to-loan ratio can be greater than one for several reasons. First, banks may ask for more collateral than the loan value, since the collateral may also include liquidation costs or legal costs, or other risks attached to the collateral. Second, depending on the type of collateral posted, such as residential property, banks require collateral up to 200% of the loan value. Third, firms must post collateral for the whole credit line (or multiple credit lines) requested, even if the initial loan withdrawal is less than amount. We therefore winsorize the collateral-to-loan ratio at the 5% level. Also note that book and market value of the collateral is the same since we observe each loan and collateral posted only once in a given month given our focus on new issuances.

[33]The results in panels A and B are robust to splitting new loans by maturity and also by currency, and are available on request from the authors.

[34]The mean of log(VIX) is 2.93 and minimum of log(VIX) is 2.38 for the monthly data series.

Table 6. Impact of GFC on Loan-Level Borrowing Constraints

	Panel A. Nominal Interest Rate			
	(1)	(2)	(3)	(4)
log(VIX)	0.032^a			
	(0.004)			
Collateral/Loan	-0.002^b	-0.002^a	-0.004^a	-0.004^a
	(0.001)	(0.001)	(0.001)	(0.001)
Collateral/Loan×log(VIX)	-0.004^a	-0.003^a	-0.0002	0.002
	(0.001)	(0.001)	(0.001)	(0.002)
FX	-0.080^a	-0.082^a	-0.080^a	-0.082^a
	(0.002)	(0.002)	(0.003)	(0.004)
Observations	16,578,792	16,578,646	11,618,532	10,096,920
R-squared	0.620	0.696	0.841	0.859
Bank×firm F.E.	Yes	Yes	Yes	No
Bank×month F.E.	No	Yes	No	No
Firm×month F.E.	No	No	Yes	No
Bank×firm×month F.E.	No	No	No	Yes

	Panel B. Loan Volume			
	(1)	(2)	(3)	(4)
log(VIX)	-0.090^a			
	(0.015)			
Collateral/Loan	0.105^a	0.111^a	0.089^a	0.091^a
	(0.005)	(0.005)	(0.010)	(0.011)
Collateral/Loan×log(VIX)	0.017^c	0.034^a	0.025^c	0.030^b
	(0.010)	(0.008)	(0.013)	(0.015)
FX	0.438^a	0.432^a	0.488^a	0.560^a
	(0.019)	(0.017)	(0.038)	(0.048)
Observations	16,578,792	16,578,646	11,618,532	10,096,920
R-squared	0.736	0.741	0.840	0.851
Bank×firm F.E.	Yes	Yes	Yes	No
Bank×month F.E.	No	Yes	No	No
Firm×month F.E.	No	No	Yes	No
Bank×firm×month F.E.	No	No	No	Yes

Notes: This table presents results for regressions using monthly data at the loan level at the origination date for the collateral regressions for (9). All variables are measured at the loan level, where VIX is the lagged end-of-month value, 'Collateral/Loan' ratio is the collateral-to-loan ratio; FX is a 0/1 dummy indicating whether a loan is in foreign currency (= 1) or domestic (= 0). We demean both the collateral ratio and log(VIX). Panel A presents results for the nominal interest rate, Panel B present results for the natural logarithm of loan value. Column (1) includes the standard macroeconomic controls and a time trend, while column (2) includes bank×month fixed effects, column (3) includes firm×month fixed effects, and column (4) includes bank×firm×month fixed effects. The regressions further include fixed effects for (i) bank defined risk weights, (ii) sectoral activity of loan, and (iii) maturity levels. Standard errors are double clustered at the firm and month levels, and 'a' indicates significance at the 1% level, 'b' at the 5% level, and 'c' at the 10% level.

on the parameter estimates in column (4). Therefore, when VIX moves from its mean to its minimum level in the sample, the loan-level collateral constraint relaxes very little from 0.091 to 0.074, an amount of 0.017. So now an increase in the collateral ratio equivalent to its interquartile range of the collateral ratio of new loans implies that during low VIX periods the response of new loan volumes is 7.0 percentage points. This is a very small relaxation in the loan-level collateral constraint as a response to exogenous capital flows; a mere 1.6 percentage points.[35]

Overall, we interpret these findings as additional evidence for the importance of impact of the fall in interest rates for *all* loans given a drop in the risk premium relative to the collateral constraint (relaxation) channel as a result of GFC-driven capital inflows. During times of low VIX, where global liquidity is presumably high, banks obtain cheap funding and they pass this on to firms as lower borrowing costs. Since firm-level borrowing costs include firm-level risk, during periods of low global uncertainty, banks might assign lower risk to some of the risky (low net worth) firms and offer them lower interest rates. However, collateral constraints at the loan level still prevent some of these firms from further borrowing even when they can finance their borrowing at a lower cost.

One can rationalize these findings with models such as Fostel and Geanakoplos (2015). These authors show an equilibrium relationship between interest rate and collateral-to-loan ratio given the equilibrium price level of collateral. In this framework a higher loan-to-value ratio (a lower collateral-to-loan ratio) is associated with higher interest rates, as we document in our data. Hence, if capital inflows do not affect the collateral valuation directly – as presumably the case in our data given the fact that capital inflows go to the banking sector – but if capital inflows affect the supply of loans then the interest rate lowers. This means that for a given level of collateral value/price, firms can borrow more at a lower interest rate.

5.3 Exchange Rate Changes and the Risk-Taking Channel

Finally, we explore the possibility for an alternative channel driving our main findings. Recent work has pointed to the role of global financial intermediaries in driving credit cycles of domestic economies via the "risk-taking channel," whereby fluctuations in the exchange rate affect the net worth of borrowers and relax the leverage constraint of lenders (e.g., Bruno and Shin, 2015b). In

[35] Recall that the elasticity of loan amount with respect to VIX is 0.067 in our macro regressions. Although 0.067 is an elasticity and here we move VIX from its mean to its minimum value, the difference in the overall impact on loan growth between two sets of estimates is sizeable, where the macro regression estimate implies a much larger impact of VIX.

particular, an appreciation of the domestic currency vis-à-vis the USD improves domestic firms' balance sheets, allowing lenders to lend more to these borrowers.

The mechanism is relevant for domestic firms who have debt in US dollars since the shock is on the nominal exchange rate. We control for exchange rate fluctuations in our regressions, but there might still be an interaction effect where such fluctuations affect certain banks and firms as envisioned by the models. Although these models have firms directly borrowing from global banks, we can still test for this possible channel in our set up where firms borrow from domestic banks, who in turn borrow from international markets, since firms can also borrow in foreign currency from domestic banks.[36]

Table 7. Impact of the GFC on Exchange Rate Fluctuations and Risk-Taking

	Panel A. Nominal Interest Rate		**Panel B.** Loan Volume	
	(1)	(2)	(3)	(4)
$\text{Leverage}_b \times \text{FXshare}_f \times \log(\text{VIX})$	-0.003^b		0.041	
	(0.002)		(0.032)	
$\text{Leverage}_b \times \text{FXshare}_f \times \Delta\log(\text{XR})$		-0.009		-0.053
		(0.007)		(0.096)
FX	-0.070^a	-0.070^a	0.688^a	0.688^a
	(0.003)	(0.003)	(0.013)	(0.013)
Observations	9,280,825	9,280,825	9,280,825	9,280,825
R-squared	0.884	0.884	0.877	0.877
Bank×firm F.E.	Yes	Yes	Yes	Yes
Firm×quarter F.E.	Yes	Yes	Yes	Yes
Bank×quarter F.E.	Yes	Yes	Yes	Yes

Notes: This table presents results for the risk-taking channel regressions using quarterly data for all loans. Columns (1) and (2) in Panel A use use the natural logarithm of the weighted average of nominal real interest rates for loans between a firm-bank as the dependent variable , and columns (3) and (4) in Panel B use the natural logarithm of total loans between a firm-bank as the dependent variable. Columns (1) and (3) present the triple interaction with lagged log(VIX); column (2) and (4) the triple interaction using the log change of the lagged TL/US dollar nominal exchange rate. Leverage_b is a 0/1 dummy variable indicating whether a bank has a high (= 1) or low (= 0) leverage bank; FXshare_f is a 0/1 dummy variable indicating whether a firm has a high (= 1) or low (= 0) share of loans in foreign currency denomination. The FX, macroeconomic, banking and trend variables are all included and defined as in Table 1. Standard errors are double clustered at the firm and quarter levels, and '*a*' indicates significance at the 1% level, '*b*' at the 5% level, and '*c*' at the 10% level.

We run a triple interaction specification, which interacts the log change of the Turkish lira-US dollar exchange rate and log(VIX) with a dummy variable indicating whether a bank is either a

[36] As discussed above, Turkish corporate borrowing from foreign banks inside or outside the country and firms' direct external bond issuance are minimal.

low or a high leverage bank on average throughout the sample, and also with a measure of the FX share of a firm's liabilities. We consider the VIX interaction in addition to the exchange rate interaction to further test whether the GFC transmission has heterogeneous impacts depending on firms' balance sheet positions. Since the firm-level balance sheet data are not broken down by currency, we construct a proxy for the FX share using the currency composition of firms' loans in the credit register. In particular, we calculate the FX share of loans for each firm over the sample, and divide firms into low and high FX share bins, based on the median in the whole sample of firms. Therefore, a firm with an average FX share of loans higher than the sample median is assigned a one, while firms with a lower share is assigned a zero.

Table 7 presents results for these regressions using quarterly data, where we use aggregate loans for a given firm-bank pair in a quarter as in our benchmark regressions. We present specifications that control for both firm×quarter and bank×quarter effects. First, the coefficient on the VIX interaction with bank leverage and firm FX exposure dummies is negative and significant at the 5% level for the interest rate in column (1), implying that highly leveraged banks actually *increase* lending rates to firms with high FX exposure when VIX falls. Furthermore, the interaction coefficient is insignificant for loan volume in column (3). This means that our previous result where we showed banks with higher non-core funding lowering nominal rates and extending more credit during low VIX periods cannot be explained by the alternative risk-taking channel. That is, these banks extend more credit to all firms and not necessarily extend more credit to firms with more dollar debt relative to firms who do not have dollar debt.

The specifications in columns (1) and (3) may not be the right ones to test the risk-taking channel since this channel should operate via movements in the the exchange rate. Hence, columns (2) and (4) interact dummies for high leverage bank and high FX exposure firm with the log change in the exchange rate. Again, the risk-taking channel cannot explain the reduction in borrowing costs given the insignificant coefficient in column (2). Furthermore, this channel is not present when looking at the loan regressions in column (4). This might be because of the fact that the changes in the exchange rate were not very large during our sample period. Thus, the extent of the appreciations may not be large enough to induce the risk taking behavior. In addition, after 2009, there was a macroprudential policy in place that restricts FX borrowing for very small firms who operate in the non-tradeable sector.

6 Conclusion

We provide evidence on new facts that are critical in understanding the transmission of the Global Financial Cycle (GFC) to emerging markets' domestic credit conditions using administrative data covering the universe of corporate loan transactions matched to bank balance sheets for a large emerging market, Turkey, over 2003–13.

We show that there is a violation of the uncovered interest parity condition (UIP) at the firm-bank-time level. This implies that firms pay a lower interest rate when borrowing in foreign currency from their domestic banks, so there is a premium for borrowing in local currency. Furthermore, the strength of this UIP risk premium, both at the firm-bank level and at the country level, strongly co-moves with the GFC, as proxied by VIX, over time. The corollary of this result is that when VIX is low, the UIP risk premium is low and hence capital flows into Turkey, lowering domestic borrowing costs and leading to an expansion of credit for domestic firms. Notice that this cylicality in the strength of the UIP risk premium implies that there is an increase in borrowing in *local currency* alongside with foreign currency borrowing during VIX-driven capital inflows episodes. This result is different than the conventional wisdom that assumes a much higher proportion of foreign currency borrowing during capital inflow episodes related to global shocks.

Using data on pledged collateral on new loan issuances, we show that collateral constraints do not relax during GFC-driven capital inflow episodes as in standard models due to an over-valued collateral (i.e., physical assets). Rather, firms are able to borrow more due to lower borrowing costs on average, which increases their ability to pay back their loans. The main reason for this is the fact that in Turkey capital flows into the banking sector, which acts as the intermediary, and not directly into the corporate sector.

The results in this paper provide evidence on an important (yet overlooked) transmission mechanism for domestic regulators to consider when designing macro prudential policies: it is not enough to limit the foreign currency borrowing for agents in an economy, either from international capital markets or from their domestic banks, during credit boom events, as typically modeled as a capital control. Lower borrowing costs also fuel local currency borrowing if banks can fund themselves cheaply in the international markets.

References

Baskaya, Yusuf Soner, Julian di Giovanni, Şebnem Kalemli-Özcan, José-Luis Peydró, and Mehmet Fatih Ulu, "Capital Flows and the International Credit Channel," *Journal of International Economics*, May 2017, *108* (S1), S15–S22.

Bekaert, Geert, Marie Hoerova, and Marco Lo Duca, "Risk, Uncertainty and Monetary Policy," *Journal of Monetary Economics*, October 2013, *60* (7), 771–788.

Bernanke, Ben S. and Mark Gertler, "Agency Costs, Net Worth and Business Fluctuations," *American Economic Review*, 1989, *79* (1), 14–31.

_ , _ , and Simon Gilchrist, "The Financial Accelerator in a Quantitative Business Cycle Framework," in J.B. Taylor and M. Woodford, eds., *Handbook of Macroeconomics*, Vol. 1 of *Handbooks in Economics* Elsevier 1999, pp. 1341–1393.

Bruno, Valentina and Hyun S. Shin, "Cross-Border Banking and Global Liquidity," *Review of Economic Studies*, 2015a, *82* (2), 535–564.

_ and _ , "Capital Flows and the Risk-Taking Channel of Monetary Policy," *Journal of Monetary Economics*, 2015b, *71*, 119–132.

Caballero, Ricardo and Alp Simsek, "A Model of Fickle Capital Flows and Retrenchment: Global Liquidity Creation and Reach for Safety and Yield," October 2016. NBER Working Paper No. 22751.

_ and Arvind Krishnamurthy, "International and Domestic Collateral Constraints in a Model of Emerging Market Crises," *Journal of Monetary Economics*, December 2001, *48* (3), 513–548.

Cagetti, Marco and Mariacristina De Nardi, "Entrepreneurship, Frictions, and Wealth," *Journal of Political Economy*, 2006, *114* (5), 835–870.

Calvo, Guillermo A, "Capital Flows and Capital-market Crises: The Simple Economics of Sudden Stops," *Journal of Applied Economics*, 1998, *1* (1), 35–54.

Cerutti, Eugenio, Stijn Claessens, and Damien Puy, "Push Factors and Capital Flows to Emerging Markets: Why Knowing Your Lender Matters More Than Fundamentals," June 2015. IMF Working Paper No. 15/127.

Cetorelli, Nicola and Linda S. Goldberg, "Global Banks and International Shock Transmission: Evidence from the Crisis," *IMF Economic Review*, 2011, *59* (1), 41–76.

Chari, Anusha, Karlye Dilts Stedman, and Christian Lundblad, "Taper Tantrums: QE, its Aftermath and Emerging Market Capital Flows," June 2017. NBER Working Paper No. 23474.

Chinn, Menzie D. and Jeffrey A. Frankel, "More Survey Data on Exchange Rate Expectations: More Currencies, More Horizons, More Tests," in William Allen and David Dickinson, eds., *Monetary Policy, Capital Flows and Financial Market Developments in the Era of Financial Globalisation: Essays in Honour of Max Fry*, Routledge London 2002, pp. 145–167.

Chodorow-Reich, Gabriel, "The Employment Effects of Credit Market Disruptions: Firm-level Evidence from the 2008–9 Financial Crisis," *Quarterly Journal of Economics*, 2014, *129* (1), 1–59.

Coimbra, Nuno and Hélène Rey, "Financial Cycles with Heterogeneous Intermediaries," March 2017. NBER Working Paper No. 23245.

Cooley, Thomas, Ramon Marimon, and Vincenzo Quadrini, "Aggregate Consequences of Limited Enforceability," *Journal of Political Economy*, 2004, *112* (4), 817–847.

Engel, Charles, "Exhange Rates, Interest Rates, and Risk Premiums," *American Economic Review*, 2016, *106* (1), 436—474.

Farhi, Emmanuel and Ivàn Werning, "A Theory of Macroprudential Policies in the Presence of Nominal Rigidities," *Econometrica*, September 2016, *84* (5), 1645–1704.

Forbes, Kristin J. and Francis E. Warnock, "Capital Flow Waves: Surges, Stops, Flight, and Retrenchment," *Journal of International Economics*, 2012, *88* (2), 235–251.

Fostel, Ana and John Geanakoplos, "Leverage and Default in Binomial Economies: A Complete Characterization," *Econometrica*, 2015, *83* (6), 2191–2229.

Frankel, Jeffrey A. and Jumana Poonawala, "The Forward Market in Emerging Currencies: Less Biased than in Major Currencies," *Journal of International Money and Finance*, April 2010, *29* (3), 585–598.

Fratzscher, Marcel, Marco Lo Duca, and Roland Straub, "On the International Spillovers of US Quantitative Easing," 2016. Forthcoming, *Economic Journal*.

Gopinath, Gita and Jeremy C. Stein, "Banking, Trade, and the Making of a Dominant Currency," November 2017. Mimeo, Harvard University.

_ , Şebnem Kalemli-Özcan, Loukas Karabarbounis, and Carolina Villegas-Sanchez, "Capital Allocation and Productivity in South Europe," *Quarterly Journal of Economics*, 2017, *132* (4), 1915–1967.

Guerrieri, Veronica and Guido Lorenzoni, "Credit Crises, Precautionary Savings, and the Liquidity Trap," *Quarterly Journal of Economics*, 2017, *132*, 1427–1467.

Hahm, Joon-Ho, Hyun Song Shin, and Kwanho Shin, "Non-Core Bank Liabilities and Financial Vulnerability," *Journal of Money, Credit and Banking*, 2013, *45*, 3–36.

Hassan, Tarek A., "Country Size, Currency Unions, and International Asset Returns," *Journal of Finance*, 2013, *68* (6), 2269–2308.

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina, "Hazardous Times for Monetary Policy: What Do Twenty-Three Million Bank Loans Say About the Effects of Monetary Policy on Credit Risk-Taking?," *Econometrica*, 2014, *82* (2), 463–505.

Jordà, Òscar, Moritz Schularick, Alan M. Taylor, and Felix Ward, "Global Financial Cycles and Risk Premiums," October 2017. Mimeo, SF Fed, University of Bonn, and U.C. Davis.

Khan, Aubhik and Julia Thomas, "Credit Shocks and Aggregate Fluctuations in an Economy with Production Heterogeneity," *Journal of Political Economy*, 2013, *121* (6), 1055–1107.

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

Kiyotaki, Nobuhiro and John Moore, "Credit Cycles," *Journal of Political Economy*, 1997, *105* (2), 211–248.

Maggiori, Matteo, Brent Neiman, and Jesse Schreger, "International Currencies and Capital Allocation," September 2017. Mimeo, Harvard University, University of Chicago-Booth, and Columbia GSB.

Mendoza, Enrique G, "Sudden Stops, Financial Crises, and Leverage," *American Economic Review*, 2010, *100* (5), 1941–66.

Miranda-Agrippino, Silvia and Hélène Rey, "US Monetary Policy and the Global Financial Cycle," February 2018. NBER Working Paper No. 21722.

Morais, Bernardo, José-Luis Peydró, and Claudia Ruiz, "The International Bank Lending Channel of Monetary Policy Rates and QE: Credit Supply, Reach-for-Yield, and Real Effects," 2015. International Finance Discussion Papers 1137. Forthcoming, *Journal of Finance*.

Peek, Joe and Eric S. Rosengren, "Collateral Damage: Effects of the Japanese Bank Crisis on Real Activity in the United States," *American Economic Review*, March 2000, *90* (1), 30–45.

Petersen, Mitchell A., "Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches," *Review of Financial Studies*, 2009, *22* (1), 435–480.

Reinhart, Carmen M. and Kenneth S. Rogoff, *This Time Is Different: Eight Centuries of Financial Folly*, Princeton, NJ: Princeton University Press, 2009.

Rey, Hélène, "Dilemma not Trilemma: The Global Financial Cycle and Monetary Policy Independence," 2013. Jackson Hole Conference Proceedings, Federal Reserve Bank of Kansas City.

Rogers, John H., Chiara Scotti, and Jonathan H. Wright, "Unconventional Monetary Policy and International Risk Premia," June 2016. International Finance Discussion Papers 1172.

Salomao, Juliana and Liliana Varela, "Exchange Rate Exposure and Firm Dynamics," 2016. Mimeo, University of Minnesota and University of Houston.

Schnabl, Philipp, "The International Transmission of Bank Liquidity Shocks: Evidence from an Emerging Market," *Journal of Finance*, 2012, *67* (3), 897–932.

Staiger, Douglas and James H. Stock, "Instrumental Variables Regression with Weak Instruments," *Econometrica*, 1997, *65* (3), 557–586.

Stock, James H, Jonathan H Wright, and Motohiro Yogo, "A Survey of Weak Instruments and Weak Identification in Generalized Method of Moments," *Journal of Business & Economic Statistics*, October 2002, *20* (4), 518–529.

Virgiliu, Midrigan and Daniel Xu, "Finance and Misallocation: Evidence from Plant-Level Data," *American Economic Review*, 2014, *104* (2), 422–458.

APPENDIX FOR ONLINE PUBLICATION

Appendix A UIP Regressions

To assess the validity of uncovered interest parity (UIP) in the context of Turkey, we run a standard UIP regression, with and without time trend:

$$i_t - i_t^* = \alpha + \lambda_t + \beta \mathbb{E}_t \Delta e_{TL/USD,t+1} + \epsilon_t, \tag{A.1}$$

where i and i^* denote loan-weighted average of all TL loan rates in a given period and the US Federal Funds rate at time t respectively. Exchange rate expectations are based on data from a survey of forecasters of the one-year ahead expected Turkish lira-U.S. dollar, which are collected at the monthly frequency. The expected quarterly (t to $t+1$) exchange rate change, $\mathbb{E}_t \Delta e_{TL/USD,t+1}$, is calculated by taking the difference of the quarterly average of the monthly expectations. These data run from 2006Q4 to 2013Q4. λ_t denotes the time trend. Before we run the regressions, we perform an augmented Dickey-Fuller unit-root test, which shows that the included variables are stationary.

Table A1 reports the estimates for (A.1). It also shows the correlation of regression residuals with VIX. As can be seen, the coefficients on the expected changes in the exchange rate are always significantly different from one, and there is a high correlation of the regression residuals with log(VIX). That is, with low VIX country risk goes down and vice versa. The correlation between the residuals and VIX is 71.5 percent if we do not include a time trend (column 1) and 71 percent if we include a time trend (column 2).

Appendix B Regression Details

B.1 Instrumental Variables' Two-Stage Regression Strategy

We estimate the instrumental regression for (5) in two-stages, where we instrument with VIX in our baseline regression. Given that all controls are either at the country or bank level, and vary over time, we run the first-stage regression for capital flows at the {bank, quarter} level, which allows us to exploit all data included in the second-stage, while maintaining a balanced panel at the bank level. Furthermore, we include bank fixed effects in order to exploit the within time variation, which is equivalent to the second-stage approach in estimating (5) with bank×firm fixed effects.

The first-stage estimation equation for quarter q is then:

$$\log \text{Capital inflows}_{b,q} = \alpha_b + b_1 \log \text{VIX}_q + b_2 \text{Trend}_q + \mathbf{B}_1 \mathbf{Bank}_{b,q} + \mathbf{B}_2 \mathbf{Macro}_q + w_{b,q}, \quad \text{(B.1)}$$

where **Macro** captures the various macro controls we will use, depending on the specification, and we use the predicted values for capital inflows at $q-1$ in the second-stage of (5). Note that there is a small difference in notation however, where given the inclusion of the exogenous bank variables in (B.1), the predicted capital inflows measure may differ due to the cross-sectional difference of the bank variables at time q.[37] In particular, the capital inflows measure is repeated for each bank b in a given quarter q.

B.2 Aggregate Implications of Reduced-Form Regressions

There is a natural aggregation exercise to undertake in order to examine the economic significance of our micro estimates on overall credit growth. In particular, ignoring the other control variables and intercept coefficients (i.e., fixed effects), we can write the VIX-predicted Loan variable from estimating (5) as

$$\log(\widehat{\text{Loan}_{f,b,d,q}}) = \widehat{\widehat{\beta}} \log(\text{VIX}_{q-1}), \quad \text{(B.2)}$$

where $\widehat{\beta}$ is the estimated coefficient. First, differentiate both sides of (B.2), and then multiply this equation by $w_{f,b,d,q-1}$, which is a firm-bank-denomination loan share viz. total loans in a given lagged quarter, such that $\sum w_{f,b,d,q-1} = 1$ by definition. These manipulations yield

$$w_{f,b,d,q-1} \text{dlog}(\widehat{\text{Loan}_{f,b,d,q}}) = w_{f,b,d,q-1} \widehat{\widehat{\beta}} \text{d} \log(\text{VIX}_{q-1}), \quad \text{(B.3)}$$

so,

$$w_{f,b,d,q-1} \left(\widehat{\frac{\Delta \text{Loan}}{\text{Loan}}} \right)_{f,b,d,q} = w_{f,b,d,q-1} \widehat{\widehat{\beta}} \left(\frac{\Delta \text{VIX}}{\text{VIX}} \right)_{q-1}, \quad \text{(B.4)}$$

where (B.4) comes from rewriting the change in logs from (B.3) as a growth rate, and $\left(\widehat{\frac{\Delta \text{Loan}}{\text{Loan}}}\right)_{f,b,d,q}$ is the predicted growth rate in Loan between quarter $q-1$ and q, while $\left(\frac{\Delta \text{VIX}}{\text{VIX}}\right)_{q-1}$ is the growth rate of VIX between quarter $q-2$ and $q-1$. Next, summing (B.4) over $\{f, b, d\}$ in a given quarter

[37] Omitting the FX dummy in (B.1) does nothing. Including it would imply needing to double the number of observations, but the inclusion of the bank fixed effect then makes the FX dummy redundant in the panel, so no additional information is gained in the regression and the estimated coefficients for other variables are identical.

q, we have

$$\left(\frac{\Delta \widehat{\text{Agg. Loan}}}{\text{Agg. Loan}}\right)_q = \widehat{\widehat{\beta}} \left(\frac{\Delta \text{VIX}}{\text{VIX}}\right)_{q-1}, \tag{B.5}$$

which yields a relationship between aggregate credit growth (Agg. Loan), the growth rate of the VIX variable and the estimated micro estimate $\widehat{\widehat{\beta}}$.

B.2.1 Importance of Internationally Connected Banks

To quantify the importance of large internationally connected banks in transmitting the GFC to the domestic credit market, we use the point estimates from Table 4, column (3), which is based on (7) where we drop the firm×quarter fixed effects, and use macro controls instead.[38] Ignoring these controls and the bank controls for brevity, the regression equation can be summarized as:

$$\log \mathrm{Y}_{f,b,d,q} = \alpha_{f,b} + \lambda \text{Trend}_q + \beta_1 \text{VIX}_{q-1} + \beta_2 (\text{Noncore}_b \times \log \text{VIX}_{q-1}) + \vartheta_{f,b,d,q}.$$

Given the estimates of β_1 and β_2, we then follow the same procedure as for the macro regression above, based on weights for high non-core banks (HNC) and low non-core banks (LNC). To begin, we predict individual loan growths based on bank type and weight these growth rates:

$$w_{f,b,d,q-1}\left(\frac{\widehat{\Delta \text{Loan}}}{\text{Loan}}\right)_{f,b,d,q} = w^{HNC}_{f,b,d,q-1}(\widehat{\beta}_1 + \widehat{\beta}_2)\left(\frac{\Delta \text{VIX}}{\text{VIX}}\right)_{q-1} + w^{LNC}_{f,b,d,q-1}\widehat{\beta}_1 \left(\frac{\Delta \text{VIX}}{\text{VIX}}\right)_{q-1}.$$

We next sum over the $\{f, b, d\}$ in a given quarter q:

$$\left(\frac{\Delta \widehat{\text{Agg. Loan}}}{\text{Agg. Loan}}\right)_q = \sum w^{HNC}_{q-1}(\widehat{\beta}_1 + \widehat{\beta}_2)\left(\frac{\Delta \text{VIX}}{\text{VIX}}\right)_{q-1} + \sum w^{LNC}_{q-1}\widehat{\beta}_1 \left(\frac{\Delta \text{VIX}}{\text{VIX}}\right)_{q-1}$$

to obtain the aggregate quarterly growth rate. We then repeat this aggregation using only the HNC bank sample, and take the average of this HNC growth rate over the sample to the average of the overall aggregate growth rate:

$$\frac{\text{Avg}\left\{\sum w^{HNC}_{q-1}(\widehat{\beta}_1 + \widehat{\beta}_2)\left(\frac{\Delta \text{VIX}}{\text{VIX}}\right)_{q-1}\right\}}{\text{Avg}\left\{\left(\frac{\Delta \widehat{\text{Agg. Loan}}}{\text{Agg. Loan}}\right)_q\right\}}.$$

[38] Note that the point estimates on the interaction between the non-core ratio and log(VIX) with and without fixed effects in column (3) and (4) are not statistically different.

This ratio is equal to 0.95, thus highlighting the important contribution of internationally connected banks in transmitting the GFC to domestic credit market growth.[39]

B.3 Reduced-Form Regressions: Robustness

We present several robustness tests for our benchmark reduced-form regression studying the impact of VIX on interest rates in Table A8.[40] Column (1) includes firm×year effects. Since our regressions are at the quarterly level, any quarter fixed effect will absorb the direct effect of VIX, but time dummies at the yearly level will not absorb VIX's effect. Hence, we employ firm×year fixed effects to control for slow moving firm-level unobserved heterogeneity. Column (2) shows that results are robust when using a sub-component of VIX that represents risk aversion, and which is computed following Bekaert et al. (2013),[41] rather than total VIX. Column (3) uses a subset of the data that only includes firms that borrow from multiple banks in a given quarter. Results are identical in these columns and very close to the benchmark result of Table 3. Next, columns (4) and (5) split the sample of loans by maturity, where short-term loans are the ones that mature during a year, and long-term loans have maturities over a year. We use remaining maturity in a given quarter and not the maturity at origination. Results are again similar to our benchmark elasticity of 0.019. In columns (6) and (7), we look at the pre-/post-crisis period for nominal rates. We define the pre-crisis as the period from 2003q1 to 2008q4 and post-crisis period as 2009q3 to 2013q4. With this definition, we leave out the observations where VIX registers a big spike.

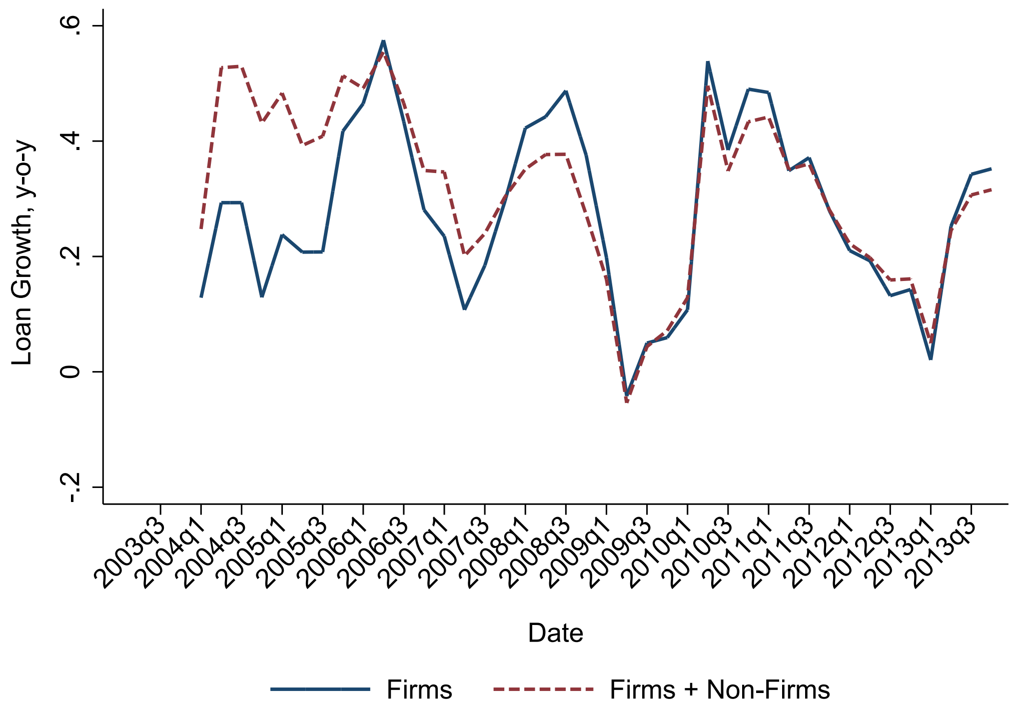
Finally, the last three columns split the sample by bank type, with column (8) considering only private banks, while columns (9) and (10) split the sample between domestic and foreign banks. The point estimate on domestic banks is considerably larger than that of the foreign banks' one, and more in line with our baseline esitmate of 0.019. This points to the central role of domestic banks for our results.

[39]If we instead use the non-core interaction coefficient estimate for $\widehat{\beta}_2$ and firm-bank sample from column (4) for the fixed effects regression, the ratio drops to 0.86, which is still economically large.

[40]Results for the loan regressions are similar, and available from the authors upon request.

[41]We would like to thank Marie Horoeva for providing us with an updated series.

Figure A1. Loan Growth Comparison of Corporate Sector and Whole Economy, 2003–13



Notes: This figure plots the year-on-year loan growth rate each quarter of our sample of firms ('Firms') with that of for the whole economy ('Firms + Non-Firms'). All values are nominal. Source: authors' calculations based on official credit register data, CBRT.

Table A1. UIP Regressions for Turkish–US Interest Rates, 2005–13

	(1)	(2)
$\mathbb{E}_t \Delta e_{TL/USD,t+1}$	0.187	0.191
	(0.116)	(0.127)
Time trend		-9.84E-05
		(0.0007)
Constant	0.132^a	0.135^a
	(0.004)	(0.022)
Observations	29	29
R-squared	0.130	0.131
Corr(ϵ, log(VIX))	0.715	0.710

Notes: This table presents UIP regressions from (A.1) using quarterly data between 2006Q4–2013Q4. The interest rate differential, $i_t - i_t^*$, is calculated as a loan-weighted average of all TL loan rates in a given period. the expected exchange rate change is calculated using survey data as described in Appendix A. Columns (1) presents the regressions without a time trend, and column (2) linear trend. Robust standard errors are used, and 'a' indicates significance at the 1% level, and 'b' at the 5% level.

Table A2. Credit Register FX Breakdown, 2003–13

	(1)	(2)	(3)
	Share of FX Loans in All Loans		
	Overall	In FX	FX-Indexed
2003	0.557	0.537	0.020
2004	0.469	0.445	0.024
2005	0.512	0.434	0.077
2006	0.534	0.453	0.081
2007	0.506	0.405	0.100
2008	0.558	0.471	0.087
2009	0.504	0.430	0.074
2010	0.480	0.409	0.071
2011	0.512	0.440	0.071
2012	0.446	0.376	0.070
2013	0.473	0.399	0.074

Notes: This table presents annual summary statistics of the credit register coverage of loans, over the 2003–13 period, using end-of-year data. Columns (1)-(3) present the FX share of loans within the data sample: column (1) presents the overall share, while columns (2) and (3) break down the share between loans issued in a foreign currency ('In FX') and those that are indexed to foreign currency ('FX-Indexed').

Table A3. Credit Register Sample Coverage of Firm-Bank Relationships, 2003–13

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Bank-Firm Relationships		*Multiple Bank-Firm Share*		Av. No. Rel.
	Banks	Firms	Single	Multiple	Number	Value	per Firm
2003	39	31,837	26,411	14,479	0.354	0.681	2.668
2004	36	60,963	48,576	33,341	0.407	0.723	2.692
2005	37	94,884	75,649	51,520	0.405	0.695	2.678
2006	35	124,861	95,682	83,521	0.466	0.735	2.862
2007	37	251,862	195,596	159,611	0.449	0.731	2.837
2008	37	297,574	232,034	185,242	0.444	0.746	2.826
2009	37	338,051	267,107	191,469	0.418	0.746	2.699
2010	40	448,978	352,644	275,220	0.438	0.763	2.857
2011	42	604,522	462,782	409,097	0.469	0.776	2.886
2012	42	641,935	494,449	437,781	0.470	0.814	2.968
2013	43	776,257	595,999	518,645	0.465	0.812	2.877

Notes: This table presents annual summary statistics on the frequency of different types of firm-bank relationships within the credit register using end-of-year data. Columns (1) and (2) list the number of banks and firms, respectively; column (3) lists the number of observations where a firm has a unique banking relationship; column (4) lists the number of observations where a firm has multiple banking relationships. Columns (5) and (6) presents the share of loans (relative to total) from firms with multiple bank relationships, in terms of loan number and loan value, respectively; and column (7) presents the average number of multiple banking relationships a firm has in a given year.

Table A4. Credit Register Quarterly Summary Statistics, Firm-Bank Level, All Loans, 2003–13

Panel A. All Loans

	Obs.	Mean	Median	Std. Dev.	Min.	Max.
Loan	19,982,267	136.9	36.243	387.8	0.996	3,478
Interest Rate	19,982,267	0.147	0.131	0.100	0.001	0.54
Real Interest Rate	19,982,267	0.065	0.056	0.083	-0.081	0.37
Maturity	19,982,267	18.322	12.000	16.785	0.000	82.69

Panel B. Turkish Lira Loans

	Obs.	Mean	Median	Std. Dev.	Min.	Max.
Loan	18,714,102	96.34	33.65	261.9	0.996	3,478
Interest Rate	18,714,102	0.153	0.137	0.100	0.001	0.540
Real Interest Rate	18,714,102	0.070	0.061	0.083	-0.081	0.365
Maturity	18,714,102	18.58	12.43	16.77	0.000	82.69

Panel C. FX Loans

	Obs.	Mean	Median	Std. Dev.	Min.	Max.
Loan	1,268,165	735.9	268.0	987.1	0.996	3,478
Interest Rate	1,268,165	0.060	0.060	0.029	0.001	0.540
Real Interest Rate	1,268,165	-0.014	-0.011	0.029	-0.081	0.365
Maturity	1,268,165	14.47	8.000	16.56	0.000	82.69

Notes: This table presents summary statistics using quarterly data for aggregate firm-bank transactions over the 2003–13 period. The sample includes loans for all firm-bank pairs reported in the dataset. Panel A presents data based on pooling all FX and TL transactions at the firm-bank×quarter level; Panel B considers only Turkish lira loans, and Panel C considers only FX loans (expressed in Turkish liras). 'Loan' is the end-of-quarter total outstanding principal for all loans between a firm-bank pair, in thousands of Turkish lira and adjusted for inflation; 'Interest Rate' and 'Real Interest Rate' are the weighted average of the nominal and real borrowing rates, respectively, reported for loans between a firm-bank pair, where the weights are constructed based on loan shares between a firm-bank pair in a given quarter, and are based on either all, TL, or FX loans for Panels A-C, respectively; 'Maturity' is the weighted average of the initial time to repayment reported for loans of a firm-bank pair, which is measured in months, and where the weights are constructed based on loan shares between a firm-bank pair in a given quarter, and are based on either all, TL, or FX loans for Panels A-C, respectively.

Table A5. Banking Sector Growth, Based on Official Aggregate Data, 2003–13

	Assets/GDP	Loans/GDP	Deposit/GDP
2003	0.54	0.14	0.33
2004	0.55	0.18	0.34
2005	0.6	0.23	0.37
2006	0.64	0.28	0.39
2007	0.67	0.32	0.41
2008	0.74	0.37	0.46
2009	0.84	0.39	0.51
2010	0.92	0.48	0.56
2011	0.94	0.53	0.54
2012	0.97	0.56	0.54
2013	1.11	0.67	0.60

Notes: This table shows the banking sector's assets, loans, and liabilities relative to GDP. The banking sector variables are created by aggregating the official bank balance sheet data for the end of year. GDP data are also sourced from the CBRT.

Table A6. Bank-Level Quarterly Summary Statistics, Based on Official Bank-Level Balance Sheet Data, 2003–13

	Obs.	Mean	Median	Std. Dev	Min.	Max.
Log (Total Real Assets)	1,685	14.40	14.47	2.230	8.387	18.31
Capital Ratio	1,685	0.145	0.138	0.044	0.064	0.198
Leverage Ratio	1,685	7.684	7.254	2.756	5.041	15.68
Liquidity Ratio	1,685	0.400	0.335	0.217	0.018	0.960
Noncore Ratio	1,685	0.298	0.227	0.224	0.000	0.907
ROA	1,685	0.012	0.010	0.010	0.000	0.033

Notes: This table presents summary statistics using quarterly data pooled over the 2003–13. 'Total Assets' are in nominal terms. The 'Capital Ratio' is equity over total assets; the 'Liquidity Ratio' is liquid assets over total assets; the 'Noncore Ratio' is non-core liabilities over total liabilities; and 'ROA' is return on total assets. Noncore liabilities = Payables to money market + Payables to securities + Payables to banks + Funds from Repo + Securities issued (net).

Table A7. Turkish and Foreign Macroeconomic and Financial Quarterly Summary Statistics, 2003–13

	Obs.	Mean	Median	Std. Dev	IQR	Min.	Max.
Real GDP Growth (q-o-q)	44	0.012	0.012	0.017	0.022	-0.059	0.048
Inflation (q-o-q, annualized)	44	0.089	0.069	0.066	0.073	-0.013	0.322
$\Delta e_{TL/USD,t}$ (q-o-q)	44	0.006	0.001	0.066	0.058	-0.104	0.271
$\mathbb{E}_t \Delta e_{TL/USD,t+1}$ (q-o-q)	29	0.010	0.004	0.047	0.056	-0.075	0.167
CBRT overnight rate	44	0.188	0.182	0.113	0.118	0.067	0.517
Expected annual inflation (y-on-y)	44	0.088	0.07	0.049	0.017	0.055	0.264
CA/GDP	44	-5.144	-5.379	3.63	2.227	-9.803	-1.303
log(Capital inflows)	44	18.25	18.61	0.926	0.730	15.92	19.22
log(VIX)	44	2.957	2.913	0.368	0.567	2.401	4.071

Notes: This table presents summary statistics for quarterly Turkish and world macroeconomic and financial data. All real variables are deflated using 2003 as the base year. Turkish macroeconomic data are sourced from the CBRT. Turkish real GDP growth, inflation, and actual and expected exchange rate changes viz. the USD are all quarter-on-quarter; while expected inflation, which is used to calculate real rates, is year-on-year. The VIX and the CBRT overnight rate are quarterly averages. 'IQR' stands for the interquartile range. Turkish capital inflows are in real Turkish lira. 'CA/GDP' variables measure the quarterly Turkish current account relative to GDP, while 'log(Capital inflows)' is the natural logarithm of gross real capital inflows into Turkey.

Table A8. Impact of VIX's Spillovers on Borrowing Costs: Robustness Checks

	Whole Sample		*Multi-Bank*	*Maturity*	
	Firm×year F.E.	Risk Aversion	*Links*	Short	Long
	(1)	(2)	(3)	(4)	(5)
log(VIX)	0.012^a	0.010^a	0.020^a	0.019^a	0.021^a
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
FX	-0.070^a	-0.070^a	-0.070^a	-0.077^a	-0.050^a
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
Observations	19,173,132	19,982,267	9,176,769	9,891,414	9,758,665
R-squared	0.881	0.792	0.761	0.805	0.846
Bank×firm F.E.	Yes	Yes	Yes	Yes	Yes
Macro controls & trend	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes
Firm×year F.E.	Yes	No	No	No	No
	Crisis Period			*Bank Type*	
	Pre	Post	Private	Domestic	Foreign
	(6)	(7)	(8)	(9)	(10)
log(VIX)	0.036^a	0.018^a	0.025^a	0.022^a	0.008^a
	(0.008)	(0.004)	(0.003)	(0.004)	(0.003)
FX	-0.091^a	-0.056^a	-0.071^a	-0.069^a	-0.071^a
	(0.004)	(0.001)	(0.003)	(0.003)	(0.003)
Observations	3,419,896	13,714,022	13,376,195	14,514,150	5,440,975
R-squared	0.778	0.873	0.795	0.721	0.871
Bank×firm F.E.	Yes	Yes	Yes	Yes	Yes
Macro controls & trend	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes
Firm×year F.E.	No	No	No	No	No

Notes: This table presents robustness results for the OLS regressions for (6) using quarterly data for all loans. All regressions use the natural logarithm of one plus the weighted-average of nominal interest rates for loans between a firm-bank as the dependent variable. VIX is the lagged quarterly average. The FX, macroeconomic, banking and trend variables are all included and defined as in Table 1. Regressions are all weighted-least square, where weights are equal to the loan share, and standard errors are double clustered at the firm and quarter levels. '*a*' indicates significance at the 1% level, '*b*' at the 5% level, and '*c*' at the 10% level.