International Spillovers and Local Credit Cycles*

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Abstract

We show that capital inflows are important drivers of domestic credit cycles using a firm-bank-loan level dataset for a representative emerging market. Instrumenting inflows by changes in global risk appetite (VIX), we find that a fall in VIX leads to a large decline in real borrowing rates and an expansion in credit supply. Estimates explain 40% of observed cyclical corporate credit growth. The OLS-elasticity of interest rates vis-à-vis capital inflows is smaller than the IV-elasticity. Banks with higher non-core funding offer relatively lower rates to low net worth firms, but do not extend more credit to them given collateral constraints.

JEL Classification: E0, F0, F1

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1 Introduction

The past decade has witnessed emerging markets receiving the bulk of world capital flows. These flows have been volatile, and the relative importance of pull versus push factors in driving them is still a source of heated debate, particularly in the context of near-zero interest rates in advanced economies. Recent research has pointed to the existence of a global push factor, which manifests itself in the form of a "global financial cycle" (Rey, 2013).[1] This cycle is characterized by the comovement of capital flows and asset prices, where this comovement results from common global factors.[2]

The empirical evidence on *how* the global financial cycle impacts domestic credit conditions is scarce. Specifically, there is no evidence on whether *exogenous* capital inflows fuel a domestic credit expansion by transmitting cheap funding conditions in international markets into reduced costs of financing for domestic agents. There are two challenges that have hindered researchers in studying this issue. First, separating the impact of push and pull factors for capital inflows in the aggregate data is challenging. Second, identifying the supply impact of push factors driven capital flows on domestic borrowing costs and credit expansion is difficult without data on both quantities *and* prices of debt contracts.

This paper tackles these challenges by exploiting a unique administrative loan-level dataset for the corporate sector, which is matched to bank and firm-level balance sheet data for an important emerging market, Turkey. These data provide an invaluable opportunity to explore the link between global and domestic financial conditions for a typical emerging market economy, which has received surges of capital inflows over the past decade. We focus on quantifying the impact of capital inflows on domestic credit volume and borrowing costs. The availability of loan-level data is crucial because it allows us to control for latent bank and firm characteristics, both time invariant and time varying, which, if omitted,

[1]See Calvo et al. (1993, 1996); Fernandez-Arias (1996) for early work on push-pull factors for *net* capital flows.

[2]See Bruno and Shin (2015a,b); Miranda-Agrippino and Rey (2015); Rey (2016) for studies focusing on the transmission of global financial factors across countries, and the role of the banking sector and US monetary policy in this transmission. Fratzscher (2011) and Forbes and Warnock (2012) show that global risk appetite is associated with capital inflows into emerging markets during the pre-2009 period. See also Cerutti et al. (2015), who emphasize the sensitivity of the correlation between capital inflows and global push factors to different types of flows and foreign investor types, where banking flows are always positively correlated with global risk appetite, proxied by VIX.

would lead to biased estimates for firm level borrowing costs and bank level credit provision. Furthermore, our data allow us to study the impact of heterogeneity at the bank, firm, and loan currency denomination levels over time.

We begin by isolating push factors driven capital inflows into Turkey by instrumenting them with a commonly used proxy for global risk appetite, the VIX.[3] The intuition for why VIX is a valid instrument for capital inflows lies in the relationship between country risk and capital inflows. During low levels of global risk, investors are more willing to tolerate higher levels of country risk associated with investing in emerging markets. Put differently, if country risk has a global component and a country-specific component, country risk will go down "exogenously" as a result of a decrease in global risk, which we measure with a fall in VIX. Our simple open-economy framework shows that, based on a standard uncovered interest parity (UIP) condition, a decrease in country risk triggers capital inflows and leads to convergence of real borrowing costs in Turkey and abroad.

Our identifying assumptions for VIX to be a valid instrument are as follows. First, movements in VIX are exogenous to domestic fundamentals in Turkey. Second, VIX affects domestic credit growth and borrowing costs in Turkey only through capital inflows. Movements in VIX may still be correlated with firm-level demand for credit through both an aggregate and a firm-level demand channel. For example, movements in VIX arising from changes in the US monetary policy may also affect firms' expectations of future economic conditions, especially if Turkish monetary policy moves with the US policy. Such an expectations channel may impact domestic credit demand and capital inflows. Or domestic monetary policy, responding to global conditions, may have a direct impact on capital inflows and domestic credit cycle. Hence, we design an estimation strategy that exploits a clear prediction on whether firm-level borrowing rates rise or fall with capital inflows, depending on whether firms' borrowing is driven by the demand or supply of credit. For this strategy, it is important to condition on domestic monetary policy changes and also to control for changes in domestic fundamentals, such as movements in GDP, exchange rates, and inflation.

[3] VIX is a forward-looking volatility index constructed by 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. Our results are qualitatively identical if we use the "volatility stripped" component of VIX that only captures risk aversion as in Bekaert et al. (2013).

Our first key result is that during periods of high global risk appetite (low VIX), capital inflows into Turkey are higher and these low-VIX driven exogenous capital inflows lead to a decrease in nominal and real borrowing costs in Turkey and an associated credit boom. Our results can also be interpreted as showing that when global risk is high, capital inflows fall, borrowing costs increase and domestic credit contracts. Importantly, the elasticity of the interest rate with respect to capital inflows is an order of magnitude larger for the VIX-instrumented capital inflows regression compared to the OLS estimate, which is what one would expect if VIX is indeed a valid instrument for supply-driven inflows. An increase in capital flows that is equivalent to its interquartile range over the sample period reduces real borrowing costs 1.6 percentage points on average according to the IV estimates as opposed to 0.2 percentage points according to the OLS estimates. This difference arises since demand and supply factors have opposite effects on borrowing rates, biasing the OLS coefficient on capital inflows towards zero.

Our results are economically significant. According to the reduced-form regressions, which study the impact of VIX on Turkish credit conditions, we find a baseline micro estimate of 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, 40% of observed cyclical loan growth of the *aggregate* corporate sector over the sample period. The elasticity of the real interest rate with respect to VIX in our core specification is 0.017, implying a 1 percentage point fall in the average real borrowing rate for an increase in global liquidity equal to the interquartile range of log (VIX) over the sample period.

We show that our results are robust using multiple strategies. First, we consider numerous sample breaks, along the time, bank, and firm dimensions. We investigate, for example, the effect of VIX on domestic loan growth and pricing before and after the global financial crisis in order to show that our results are not driven by the huge spike in VIX during the crisis. Second, we investigate the role of alternative explanations, such as relaxation of collateral constraints and/or balance sheet/wealth effects that might arise due to exchange rate fluctuations. None of these explanations are supported by the data. Third, we include firm×year fixed effects in order to control for any remaining unobserved heterogeneity at the firm-year level that might also be correlated with our bank-level controls, that are at bank-quarter level given the slower reaction of firms' balance sheets. Overall, we find that our main results are robust, with changes in VIX driving credit growth via capital inflows and driving down real interest rates.

We next examine the heterogeneous impacts of changes in global risk appetite over the domestic credit cycle. This exercise allows us to examine specific mechanisms through which global conditions spillover into the domestic credit market. We first investigate whether changes in VIX have a larger impact on both the loan level and borrowing rate when credit is supplied by banks with higher non-core funding, where non-core funding encompasses everything but domestic deposits and hence is mostly raised in the international capital markets.[4] We find this to indeed be the case. Our interpretation of these findings is that banks' funding costs decrease during episodes of low global risk, which banks pass through to firms by lowering borrowing costs. Next, we ask how high non-core banks' lending varies across firms of different credit constraints (proxied by firm size or net worth), and whether such banks lend differentially in different currencies. We focus on these measures given the importance of potential balance sheet mismatches highlighted in the recent literature,[5] as well as classic work studying the interaction between the provision of funding and firms' credit constraints.[6]

We do not find any differential change in the loan amounts of high and low net worth firms when borrowing from banks with high non-core funding, in spite of the fact that low net worth firms face a larger decline in their borrowing costs from such banks during periods of low VIX. The absence of any statistically significant difference between low and high net worth firms in changes in loan amounts implies that low net worth firms increase their borrowing as much as high net worth firms from banks with higher non-core funding. Using data on collateral at the loan-month level, we show that there is a strong positive relationship between collateral and loan amounts. These findings provide evidence that some firms are collateral constrained, most likely small and low net worth firms, and cannot increase their

[4]See Akdogan and Yildirim (2014) for a discussion of Turkish banks' non-core liabilities and their relation to international funding.

[5]See Farhi and Werning (2015), who show that optimal policy in the case of local and foreign currency borrowing calls for different taxes on local and foreign currency debt. They argue that taxes on foreign currency debt should be higher. See also Aoki et al. (2015) who show that if the financial sector is borrowing in foreign currency, it might be problematic to implement cyclical macroprudential policies.

[6]See, for example, Holmstrom and Tirole (1997).

borrowing more than the non-constrained firms, even though they face a larger decline in their borrowing costs.

We also do not find any difference in terms of changes in foreign currency and domestic currency loan provision by high non-core banks during low VIX episodes, although these banks decrease their lending rates more so on domestic currency loans when VIX is low. These results are consistent with our UIP framework, where UIP may not hold due to country risk. When global risk is low, foreign investors lower their risk premium for investing in Turkey, which leads to a smaller gap in the borrowing rates for TL and FX loans over time. While FX loans are cheaper on average during our sample period, during periods of low VIX the decline in rates on TL loans is larger compared to FX loans for all firms, when we keep the lender fixed and that both loans are provided by high non-core banks.

In exploring these heterogeneous effects of the global financial cycle, we use VIX as a reduced-form measure of supply-driven capital flows, and we further saturate our regressions with time-varying fixed effects at the bank and firm levels. This fixed-effect methodology follows in the tradition of papers that use credit register data, such as Khwaja and Mian (2008) and Jiménez et al. (2014a,b), by exploiting the fact that firms borrow from multiple banks over time in order to identify heterogeneous effects at the firm and bank level. This literature almost exclusively focuses on the amount of domestic loan provisions by banks. Our contribution is to focus also on the pricing of such credit supply, and how this pricing changes with firm and bank heterogeneity, which turns out to be the key international transmission channel for the global conditions to pass through into the emerging market's domestic economy.

Our paper is related to several strands of the literature. We relate to papers that show a link between global conditions, VIX, US monetary policy and emerging market capital flows such as Forbes and Warnock (2012); Rey (2013); Fratzscher et al. (2013); Bruno and Shin (2015a,b); Cerutti et al. (2015); Miranda-Agrippino and Rey (2015); Hofmann et al. (2016).[7] Our paper adds to this literature by showing the exogenous effect of capital flows on the domestic credit cycle for a representative emerging market, pinning down the international

[7] Rey (2013) shows the causal effect of the global factor that relates to US policy and VIX, on credit growth in several countries using a structural VAR and using a narrative approach to identify US monetary policy shocks.

transmission mechanism. Capital flows pushed into the domestic economy as a result of low global risk and result in lower real borrowing costs for the borrowers, especially for low net worth ones.

A separate literature has so far established that financial crises are generally preceded by credit booms (Kindleberger, 1978; Reinhart and Rogoff, 2009; Schularick and Taylor, 2012; Jordà et al., 2013, 2015). This research argues that such booms can be driven both by abundant credit supply by banks and excessive credit demand by firms and households. Turkey provides an excellent laboratory to study the supply and demand channels for overall financial activity, linking these channels to international shocks, since banks play the primary financing and intermediary role for capital inflows in the Turkish economy. Our work provides a bridge between these literatures by showing that the domestic credit cycle can be driven by lower funding costs on banks part due to exogenous capital flows that are the source for supply of funds for banks in an emerging market.[8]

The paper proceeds as follows. Section 2 presents our simple theoretical framework and the identification methodology. Section 3 discusses the data. Section 4 describes the empirical results and presents robustness, and Section 5 concludes.

2 Framework

2.1 Conceptual Framework

In order to relate real interest rates to capital flows we start with the arbitrage condition for a foreign lender to Turkey implied by uncovered interest rate parity (UIP):

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

where i_t and i_t^* are the nominal interest rates in Turkey and the US (or the world), respectively; $\mathbb{E}_t \Delta e_{t+1}$ is the expected log exchange rate change between t and $t+1$, and γ_t is

[8] There is a large literature following Kashyap and Stein (2000) that analyses the bank lending channel. This literature tends to find that smaller banks are more sensitive to monetary policy shocks in terms of credit supply. A separate literature finds that large banks' leverage are more pro-cyclical and larger banks increase leverage more during periods of expansionary monetary policy. See Kalemli-Özcan et al. (2012); Adrian and Shin (2014) on leverage.

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 USD (i.e., $\mathbb{E}_t \Delta e_{t+1} > 0$), and by the country risk premium γ_t, which captures both exchange rate and default risks. 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.

Assuming that purchasing power parity (PPP) holds, changes in the exchange rate can be written in real terms as the inflation differential between Turkey and the US: $\Delta e_{t+1} = \pi_{t+1} - \pi_{t+1}^*$, and noting that the real interest rates in the two countries are $r_t \equiv i_t - \mathbb{E}_t \pi_{t+1}$ and $r_t^* \equiv i_t^* - \mathbb{E}_t \pi_{t+1}^*$, respectively, we can re-write the UIP condition (1) in real terms as:

$$r_t = r_t^* + \gamma_t. \tag{2}$$

Therefore, if Turkish nominal and real 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 both nominal and real interest rates and also to an appreciation of the Turkish lira viz. the USD. Crucially, any change in the risk premium will affect the real interest rate differential and hence real borrowing costs, and a lower country risk premium will imply lower real 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 γ_t as being composed of two different risks: global and country. We therefore write γ_t as

$$\gamma_t \equiv \omega \text{VIX}_t + \alpha_{c,t}, \tag{3}$$

where VIX represents global risk and $\omega > 0$ and needs not equal to one, and $\alpha_{c,t}$ is country-specific risk.

Next, assume that the risk premium for a given firm f by bank b is a linear function of the firm-specific risk:

$$\gamma_{f,b,t} \equiv \alpha_{f,t}, \tag{4}$$

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 (4), and apply the definition of the country risk factor (3):

$$\begin{aligned} i_{f,b,t} &= i_t + \gamma_{f,b,t} \\ &= i_t^* + \mathbb{E}_t(\Delta e_{t+1}) + \gamma_t + \gamma_{f,b,t} \\ &= i_t^* + \mathbb{E}_t(\Delta e_{t+1}) + \omega \text{VIX}_t + \alpha_{c,t} + \alpha_{f,t}, \end{aligned} \tag{5}$$

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. Using (2), we can apply the same logic to derive a firm-bank level real interest rate as a function of risk factors and the foreign real interest rate:

$$r_{f,b,t} = r_t^* + \omega \text{VIX}_t + \alpha_{c,t} + \alpha_{f,t}. \tag{6}$$

Therefore, conditional on US interest rates, the country risk and firm-time varying factors including idiosyncratic risk, and real borrowing costs at the firm level will be a function of global risk, proxied by VIX.

We take this simple framework to the data by using an estimation equation for the firm-bank level interest rate at the quarterly level that maps into (6).[9] We detail our empirical framework and identification strategy in the following section.

2.2 Identification Strategy

We begin with "macro regressions," which regress (i) the loan principal outstanding ('Loan'), and (ii) the real interest rate ('r') or nominal interest rate ('i') on Turkish capital inflows. Loans are deflated by Turkish CPI, while the real interest rate is constructed using Turkish survey data on year-on-year inflation expectations.[10]

[9] The direct effect of r_t^*, separate from VIX_t, is hard to estimate given the limited quarterly variation for r_t^*, measured as the US interest rates.

[10] These 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

The monthly transaction level loan data are collapsed at the firm (f)-bank (b)-currency denomination (d)-quarter (q) level. The main reason for doing this is to be consistent with capital flows data which are at the quarterly level. Further, the interest rate is a weighted-sum of individual real rates on loans between bank and firms, where the weights are based on a given loan's share relative to total loans. All explanatory variables are in real terms or in ratios. We run regressions in log-log, so that we can interpret the coefficients on VIX and capital inflows as elasticities. We then run "interaction" regressions to exploit the rich heterogeneity in the data. These regressions will take into consideration the role of bank characteristics, as well as triple interactions that examine firm characteristics and the currency denomination of the loan. We provide substantial details on all data construction below in Section 3. Regressions are all weighted-least square, where weights equal the natural logarithm of the loan value. Finally, standard errors are double clustered at the firm and time levels.[11]

2.2.1 Identification of "Push" vs. "Pull" Factors for Capital Inflows

To examine the impact of capital inflows on credit in terms of either loan volume or interest rates, we begin with the following regression:

$$\begin{aligned}\log \mathrm{Y}_{f,b,d,q} = {} & \alpha_{f,b} + \lambda \mathrm{Trend}_q + \beta \log \mathrm{Capital\ inflows}_{q-1} + \delta \mathrm{FX}_{f,b,d,q} + \Theta_1 \mathbf{Bank}_{b,q-1} \\ & + \Theta_2 \mathbf{Macro}_{q-1} + \varepsilon_{f,b,d,q},\end{aligned} \tag{7}$$

where $\mathrm{Y}_{f,b,d,q}$ is either (i) loans ($\mathrm{Loans}_{f,b,d,q}$), (ii) one plus the nominal interest rate ($1+i_{f,b,d,q}$), and (iii) one plus the real interest rate ($1+r_{f,b,d,q}$), 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

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 based on year-on-year inflation rather than using actual survey data on inflation expectations at the annual frequency yields similar results.

[11] 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.

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. **Bank** is a set of bank characteristics that control for heterogeneity, 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.

Macro is a set of macro controls, including Turkish quarterly real GDP growth, inflation, and the Turkish lira/US dollar quarterly exchange rate change.[12] These variables account for macro pull factors, and are the standard variables in central bank reaction functions. We further augment regression (7) with the lag of CBRT policy rate to directly control for monetary policy.[13] Finally, for robustness, we move one step further by augmenting (7) with *firm*×*year* effects, 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. These fixed effects map into $\alpha_{f,t}$ in equation (6).

Figure 1 plots the CBRT policy rate, that is the overnight rate, together with VIX, and the aggregated nominal interest rates on TL and FX loans in our sample. As the figure clearly shows, nominal interest rates, especially for TL loans, show a time series pattern that closely follows VIX, although at times the policy rate, deviates from VIX. Next, Figure 2 plots the average time series pattern of loan rates after purging all bank and firm characteristics

[12] In the regressions where we use real interest rate as the dependent variable, we still control quarter-on-quarter actual inflation since we used year-on-year expected inflation to calculate the real interest rates.

[13] We proxy the CBRT policy rate with the CBRT overnight lending rate throughout the sample period. Our reasoning 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 overnight borrowing rate of CBRT (before 2010) or 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, CBRT deviated from this standard policy by using an asymmetric and wide corridor since 2010 in order to incorporate financial stability into the monetary policy framework. The upper bound of the corridor is the CBRT overnight lending rate to banks and lower bound is CBRT borrowing rate. CBRT provided liquidity mainly through two distinct channels, i.e. the O/N lending and 1 week-repo lending and hence at two different interest rates since 2010 during a period where CBRT acted as a net lender. 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 overnight lending rate for their remaining liquidity needs. By using overnight lending rate as the policy rate, we would be using the upper bound for the cost of borrowing from CBRT for banks.

from the nominal and real rates at the loan level. We follow this strategy in order to show how the dynamics of these rates correlate with movements in VIX. To plot the interest rates' time effects in this figure, we regress these rates on bank×firm fixed effects, month fixed effects, and several time-varying loan characteristics such a loan's collateral-to-principal ratio, maturity, currency denomination and riskiness. We then plot the estimated month fixed effects. As in Figure 1, there is a close connection between VIX and the nominal and real borrowing costs in Turkey, and especially during the unconventional monetary policy (QE) period.

'Capital inflows' might be partly determined by firm demand, and hence without separating the pull versus push factors for capital inflows, the causal impact of supply-driven capital inflows on domestic credit conditions is not identified in (7). Studying both loan volumes and borrowing rates at the micro level and their relationship to capital flows helps tease out the relative importance of push/supply and pull/demand shocks, which would otherwise be difficult to do using aggregate data. In particular, capital might be flowing into the economy due to an increase in firm demand, an increase in credit supply, or some combination of demand and supply shocks to capital flows.

To provide some intuition on the relative impact of supply and demand shocks on the estimated coefficients in estimating regression (7) for loans and interest rates, Figure 3 presents two figures plotting out comparative statics arising from different sets of shocks. First, Figure 3a 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. Next, Figure 3b 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: $r_{\mathrm{B}} > r_{\mathrm{A}}$). 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 ($r_D < r_A$). Again, loan volume increases.

To be able to make use of this framework, where demand and supply shocks will have opposing effects on the interest rates, we need to instrument capital inflows so that we isolate these shocks. To achieve this goal, we turn to the conceptual framework outlined in Section 2.1 to motivate using VIX as an instrument for capital inflows in order to estimate the "push" impact of capital inflows on Turkey's credit market.[14] In particular, the first-stage regression instruments for log(Capital inflows) by log(VIX) in (7), which yields an IV estimate of β.[15]

We can compare the OLS and IV estimates of β for the real interest rate regressions, β_r^{OLS} and β_r^{IV}, respectively, to help tease out the supply-side effects of capital inflows. In particular, if capital inflows are driven both by demand and supply effects, and VIX is picking up a global financial cycle (Rey, 2013) and hence exogenous supply effect in a small open economy like Turkey, we would expect that the $|\beta_r^{IV}| > |\beta_r^{OLS}|$. This case will hold true as long as our identifying assumption is valid – that is changes in VIX affect Turkish loan growth through the supply-induced effect of capital inflows and hence VIX is an excludable instrument.

2.2.2 Reduced-Form Regressions

We further examine the impact of VIX directly on loans and interest rates in Turkey in a reduced-form setting, by running a regression analogous to (7), but replacing capital inflows with VIX directly:

$$\log \mathrm{Y}_{f,b,d,q} = \widetilde{\alpha}_{f,b} + \widetilde{\lambda}\mathrm{Trend}_q + \widetilde{\beta}\log \mathrm{VIX}_{q-1} + \widetilde{\delta}\mathrm{FX}_{f,b,d,q} + \widetilde{\Theta}_1 \mathbf{Bank}_{b,q-1} + \widetilde{\Theta}_2 \mathbf{Macro}_{q-1} + \xi_{f,b,d,q}. \quad (8)$$

This reduced-form approach not only provides a direct estimate of the elasticity of credit conditions in Turkey vis-a-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.

[14]There is a tight relationship between Turkish capital inflows and VIX during our sample period, where the two series (in logs) have a correlation of -0.68.

[15]See Section A.1 for details on the two-stage estimation strategy.

2.2.3 Banks' External Funding, Firm-Level Financial Constraints, and the Currency Denomination of Lending

To study how changes in global financing conditions spillover into the domestic credit market via banks' exposure to international financial markets, we follow Baskaya et al. (2016) who showed that the lending volume of banks that are more reliant on financing via non-traditional (or wholesale) funding, is more responsive to movements in capital inflows, without going into identification of what drives capital flows in the first place. This type of funding is dubbed as non-core liabilities, Hahm et al. (2013). We therefore construct a 'Noncore' ratio, which is non-core liabilities divided by total liabilities.[16]

Our empirical methodology focuses on multiple firm-bank relationships for estimating the heterogenous impact of capital flows on real lending rates and credit growth. We follow the methodology in Khwaja and Mian (2008); Jiménez et al. (2012, 2014b); Baskaya et al. (2016). These papers uses an identification methodology that relies on firms borrowing from multiple banks over time. Such a strategy allows the use of firm-quarter fixed effects to control unobserved firm characteristics such as firm productivity/quality.[17] Our regression specification is then

$$\log \mathrm{Y}_{f,b,d,q} = \alpha_{f,b} + \alpha_{f,q} + \zeta(\mathrm{Noncore}_b \times \log \mathrm{VIX}_{q-1}) + \delta_1 \mathrm{FX}_{f,b,d,q} + \epsilon_{f,b,d,q}, \tag{9}$$

where $\alpha_{f,q}$ is a firm×quarter fixed effect, observing all time-varying firm heterogeneity by focusing *only* on firms borrowing from multiple banks *over time*. $\mathrm{Noncore}_b$ is a time invariant dummy variable, for whether a bank is 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 "low").

Analyzing which banks play the largest role in passing through the global financial conditions to the domestic credit part is only part of the story. The importance of the interaction between firms' financial constraints and capital inflows on the macroeconomy has been

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

[17]We also experiment with first-difference specifications for additional robustness checks, and the qualitative results are robust.

highlighted in the international macroeconomics literature, particularly since the Global Financial Crisis.[18] Given the rich heterogeneity of our dataset, we investigate how the effect of capital flows on domestic loan provision is impacted by firm characteristics. In particular, we investigate the interaction between movements in the VIX, banks' non-core positions and firm financial constraints, which we proxy by either firm size or net worth.[19] In order to focus on the difference-in-difference estimation across firm characteristics, we create time-invariant firm-level dummy variables that split firms into two groups based on firm size and net worth.

We base our measure of firm size on the natural logarithm of firm assets. Given the skewed distribution of firm size in Turkey, and the fact that the growth rate of the corporate sector was stable across firms over the period (roughly 10%), we create a time invariant dummy for whether a firm is large or not. A firm is assigned a 1 for "large" if its average log(assets) over time is larger than the median of all firms' log(assets) over the sample; otherwise, it receives a zero (for "small"). We call this variable Size_f. Next, we define firm's net worth as log(assets-liabilities), as is standard in the literature.[20] Like the firm size dummy, we also define a time invariant dummy for firms' net worth (NetWorth_f) by comparing a firm's average net worth to the sample's median value. A value of one indicates a "high" net worth firm. The regression specifications with the triple interaction can then be written as,

$$\begin{aligned}\log \text{Y}_{f,b,d,q} = {} & \alpha_{f,b} + \alpha_{b,q} + \alpha_{f,q} + \kappa(\text{Noncore}_b \times \text{FinConstraint}_f \times \log \text{VIX}_{q-1}) \\ & + \delta_2 \text{FX}_{f,b,d,q} + \vartheta_{f,b,d,q},\end{aligned} \tag{10}$$

where $\alpha_{b,q}$ is a bank×quarter fixed effect, and 'FinConstraint_f' is either Size_f or NetWorth_f. Note that in both these specifications, quarter effects will absorb the direct effect of the VIX. The interpretation of these triple interaction regressions are such that the results are

[18] See, for example, Farhi and Werning (2015), Gopinath et al. (2015), and Caballero and Simsek (2016).

[19] Starting with Rajan and Zingales (1995), the finance literature typically documents a positive relation between size, measured as log (assets), and leverage, measured as the ratio of total liabilities to total assets. Using survey data on small firms from the National Survey of Small Business Finances (NSSBF), Berger and Udell (1998) show that firms which are younger and smaller have less capital, and hence smaller net worth. The authors conclude that lower access to finance by small firms is due to their informational opaqueness and high default risk and hence size and net worth can be proxies for financial frictions. Arellano et al. (2012) and Gopinath et al. (2015) document a positive cross-sectional relationship between firm leverage and size using AMADEUS data for several European countries.

[20] This definition normally eliminates negative net worth firms, but this is not a constraint in our data sample, since firms always have positive net worth.

driven by the interaction of firm and bank time-varying heterogeneity, and not by few firms' time-varying credit demand or by certain banks' time-varying credit supply.

The potential for balance sheet currency mismatches has been investigated in numerous studies,[21] and the potential for these to build up during credit booms is particularly acute. To study the role of banks with higher non-core liabilities on potential differentials in the FX composition of loan provision and borrowing rates, we interact the 'Noncore_b' measure with the FX dummy for the currency denomination instead, that is we run

$$\begin{aligned}\log \mathrm{Y}_{f,b,d,q} = \alpha_{f,b} + \alpha_{b,q} + \alpha_{f,q} + \rho(\text{Noncore}_b \times \text{FX}_{f,b,d,q} \times \log \text{VIX}_{q-1}) \\ + \delta_3 \text{FX}_{f,b,d,q} + u_{f,b,d,q},\end{aligned} \tag{11}$$

where we include the same set of fixed effects as in (10).

3 Data

To identify the impact of capital flows on the domestic credit cycle, we merge three large micro-level panel datasets together. All data are obtained from the CBRT. Specifically, we merge bank- and firm-level characteristics 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, except for the firm data, which are annual. We transform all loan, bank, and firm 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.[22] 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

[21] See Aguiar (2005); Bleakley and Cowan (2008); Desai et al. (2008); Kalemli-Özcan et al. (2016).

[22] We winsorize 1% of the data for the loan and bank variables, but need to winsorize 2% for the firm balance sheet variables given fatter tails.

outstanding loans at the level of firms and individuals monthly to the BRSA at the transaction level.[23] 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 of the seven 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).[24] 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

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

[24] Generally US dollar or euro (see Acharya et al., 2015).

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 US dollar 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 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 three quarter 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 bank-firm level for the given quarter, reports 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 our whole sample of corporate loans, roughly one half of the loans are in TL, and the remaining FX. Table A1 reports some key statistics on the coverage of the credit register data based on end-of-year data, both for all firm loans (Panel A), as well as for loans of the firms with matched firm balance sheet data (Panel B). 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 and 67% for all firms and the firm sub-sample with matched balance sheet data, respectively. Therefore, 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 A2 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)). In Panel B, the proportion of multiple bank relationships is even larger in terms of count, while the loan value share is comparable to that in Panel A. Finally, the average number of banking relationships a given firm has over the sample is between 2.8 and 4.3 (column (7)) for the whole sample and the matched sample, respectively.

Table A3 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 observations 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, (iv) the collateral-to-loan ratio, and (v) 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.[25] 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 employ several strategies to deal with this in the empirical section.

Since we are aggregating over several potential loans between a given bank and firm

[25]The min-max values are similar across panels due to windsorization.

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.[26] We want the weights to be time-varying to capture the time variation in the interest rates of the loan portfolio of a given bank-firm 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 it's 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.[27] The loan variable is the sum of all loans between firm-bank pair, 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 A4 shows, by 2013 the banking sector's assets represented more than 100 percent of GDP, and loans roughly 70 percent. These patterns must be viewed in a historical context: since the 2000s, fiscal repression has fallen tremendously, so that relative to the 1990s, where the banks' main task was to finance government deficits and debt (Baskaya and Kalemli-Özcan, 2016), the banking sector expansion has been driven by lending to the household and corporate sectors.[28]

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

[27]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.

[28]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 period, while the largest ten banks' shares are

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 simply 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.[29] Our sample of banks varies from between 35 and 43 throughout the period since we focus on banks that are active in the corporate loan market and this number changes from period to period.[30] Table A5 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.

3.3 Firm-Level Data

Firm balance sheet and income statement data come from a supervisory dataset that is collected by the CBRT annually, and date back to 1988. The data are collected to monitor the credit risk of firms. The CBRT sends the survey to the two groups of firms. The first group contains firms that have more than 10,000 TL credit and have appeared in the CBRT's database in previous years. The second group includes the firms that have more than 1,000,000 TL credit, but have not appeared in the CBRT's database before. Although an important fraction of the firms have continuously existed over the sample period, the firm sample has been changing over time due to real entry and exit of firms and also entry and exit arising from the Central Bank's size thresholds. The data are not drawn from the census,

between 80 to 90 percent.

[29]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.

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

and tend to be dominated by manufacturing firms. We therefore compare our dataset to data collected by the Turkish Statistical Institute (Turkstat) for a much broader set of firms and industries. The aim of this dataset (Annual Industry and Service Statistics) is to produce information based on enterprises for all sectors. The firms that are sampled in Turkstat are the universe of enterprises with more than 20 employees, as well as a representative subset of smaller firms. We also drop financial firms and state owned enterprises from our own CBRT firm database and these sectors are also not included in the Turkstat database.

Table A6 shows that our dataset's sample of firms represents on average approximately 50% of Turkey's economic activity, as measured by total gross sales (Gross Output).[31] Next, Table A7 compares the firm coverage of gross sales in our dataset relative to Turkstat across different firm-size strata, which are defined based on employment. Overall, our dataset does a relatively good job in terms of representing medium-sized firms (20-249 employees) for both all sectors of the economy, as well as the manufacturing sector. However, the firm data that are collected by the CBRT under represent small firms (1-19 employees), and thus over represent very large firms (250+ employees), though this difference in sampling is less dramatic in the manufacturing sector (Panel B).

We clean the firm-level data and winsorize variables at the 2 percent level to eliminate the impact of potential outliers. Furthermore, we deflate all nominal values to 2003 TL values. Table A8 presents summary statistics for all firms in the sample. Panel A presents data for all firms, excluding the financial and government sectors, while Panel B restricts the data to only firms in the manufacturing sector. We present all measures in levels (in thousands of 2003 TL), ratios and growth rates. It is worth noting that in terms of counts, manufacturing firms make up slightly less than 50% of the sample. There is substantial variation in all variables across firms and over time. Moreover, in comparing Panels A and B, manufacturing firms tend to be slightly larger and have higher net worth on average.

Firms' direct external borrowing is very limited in Turkey and hence banks are the key intermediary of capital flows. As Figure 4, shows, the external corporate bond issuance is negligible as percent of GDP, whereas banks' external borrowing is as high as 40 percent of

[31]Note that Turkstat has not released 2013 data yet, so we cannot compare the last year of our sample. Furthermore, our sample's balance sheet coverage also improves in later years, where there is also a large increase in loans in the Turkish economy.

GDP at the end of our sample period.

3.4 Macro-Level Data

Figure 5 plots Turkey's credit growth (Loans/GDP Growth) and current account position (CA/GDP) against the 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. Plotting the level of loans to GDP in Figure 6, we show that 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 tripling of FX loans, both as a ratio to GDP, over this period.[32]

Next, Table A9 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, the Turkish overnight rate and the US 10- year note/3-month T-bill spread are quarterly averages. There is substantial quarterly variation in all these variables, over the sample period, which is crucial for our identification strategy.

4 Empirical Results

4.1 Macro Regressions

Table 1 presents the results for the capital inflows regressions (7) for loans, and nominal and real interest rates. The regression for the real rates directly maps to equation (6) in

[32]The figure plots the aggregated loans from bank balance sheet data.

our theoretical framework.[33] 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 changes in loans and interest rates as a function of 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.

Columns (1), (3), and (5) present the OLS estimates for log(Loans), the nominal interest rate, and the real interest rate, respectively. Across all columns, we find that capital inflows to Turkey are associated with higher volume of loans as well as lower interest rates, both in nominal and real terms. Furthermore, the coefficient on the FX dummy shows that loans denominated in foreign currency are larger in value (twice the size of TL loans), and have lower interest rates on average relative to TL loans. In fact, there is a large price differential between FX and TL loans, where FX loans are 8 percentage points cheaper on average in real terms. This result is consistent with existing findings in the international macro literature on deviations from uncovered interest parity (UIP), which suggest such deviations make foreign currency borrowing cheaper. This literature shows that these UIP deviations are related to a time-varying risk premium, which is related to country/political risk.[34] Recall that we also model our UIP framework with a time-varying risk premium that has both global, country- and firm-specific components. We control for monetary policy rate in all specifications, and find that this policy variable has a significant impact on nominal interest rates, but not on loan amounts nor real interest rates.

Next, we turn to the IV estimates, in columns (2), (4), and (6) of Table 1, which instrument capital inflows with VIX using 2SLS regressions, with the identifying assumption being that the effect of the VIX on the Turkish local credit cycle is only transmitted through its effect on capital inflows. The fact that we have data both on price and quantity of loans provides us with a natural way to examine the suitability of VIX as an instrument for supply-driven capital inflows. If the supply side factors play an important role in local credit

[33] In a robustness table, we show results with firm×year fixed effects which corresponds to $\alpha_{f,t}$ in equation (6), where we use "year" for the t dimension in order not to absorb the direct effect of quarterly VIX.

[34] See among others Engel (1996); Chinn and Frankel (2002); Frankel and Poonawala (2010). See also the recent work by Salomao and Verala (2016) who model the optimal choice of foreign currency borrowing by firms, where foreign currency borrowing is more attractive under a UIP violation due to country risk.

cycles, then we would expect the elasticity of the loans and the interest rates with respect to capital inflows obtained from the IV framework to be higher than their OLS counterparts in Table 1. This is especially the case for the interest rates since, as we have argued above, demand side factors will cause upward pressure on the interest rates, working against us for finding a lower interest rate during episodes of capital inflows. Hence, if our exclusion restriction is violated and VIX affects loan quantities not via its effect on capital flows but rather its effect on expectations, then we should see higher credit demand putting upward pressure on the interest rates.

Comparing the estimated OLS and IV coefficients on capital inflows for the loan volume regressions in column (1) and (2) of Panel A in Table 1, we do not find that the IV estimated elasticity (0.040) is larger than its OLS counterpart (0.040). However, comparing the estimated IV and OLS elasticities for the nominal and real interest rates in columns (3) and (4) and (5) and (6), we see that $|\beta^{IV}_{r/i}| > |\beta^{OLS}_{r/i}|$, which points to VIX-driven capital inflows capturing an important supply/push-side effect. To quantify the difference in the OLS and IV estimates are, we calculate the effect on the real interest rate that the set of estimates imply given an increase in log capital inflows equivalent to its interquartile range. The OLS estimate implies that the average real cost of borrowing will fall by 0.2 percentage point, while the IV estimate implies a drop of 1.6 percentage points.

This downward bias in the estimated OLS coefficient for the real interest rate is indeed what one would expect to find since, as we have noted, 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 the estimated coefficients are free of the demand effect.[35] Panel B shows the first-stage regression, which indicates the strong correlation between VIX and capital inflows, as also been found in the literature (see among others, Forbes and Warnock, 2012; Cerutti et al., 2015). It should also be noted that the first-stage F-statistic is 16.35, indicating that

[35] See Appendix A.2 for discussion on the potential that the IV estimates capture a local average treatment effect.

there is no weak instruments problem (Staiger and Stock, 1997; Stock et al., 2002).[36]

Table 2 next presents the reduced-form results, where we directly use the global risk appetite, VIX, rather than the capital inflows instrumented by VIX. These specifications also control for the firm×bank fixed effects, the macroeconomic factors and linear trends as well as the bank characteristics, as in the OLS and 2SLS regressions for capital inflows. The reduced-form regressions are useful to look at because we use VIX directly in reduced-form regressions to estimate heterogeneous effects across banks, firms, and the currency denomination of loans. First, however, we use the estimated VIX coefficients in the macro regressions to quantify the effect of movements in VIX on aggregate credit growth.

Appendix A.3 provides an aggregation equation, which shows how to use the micro estimates to draw implications for *aggregate* credit growth over the cycle. Our results are economically significant. The baseline micro estimates of the elasticity of domestic loan growth with respect to changes in VIX is -0.067. In turn, applying (A.5), this *micro* estimate implies that we can explain on average 43 percent of observed cyclical *aggregate* loan growth to the corporate sector. The estimated coefficient for the effect of VIX on the real interest rate (0.017) implies a one percentage point fall in the average borrowing rate resulting from an increase in global liquidity equal to the interquartile range of log(VIX) over the sample period.

4.2 Reduced-Form Regressions and Robustness

We present several robustness tests for our benchmark reduced-form regression studying the impact of VIX on real interest rates in Table 3.[37] 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

[36]Table A10 presents results where we also include the US 10 year-3 month spread as an additional instrument. The coefficient on VIX drops slightly in the first-stage, where the two instruments now have an F-stat of 20.63, again indicating no weak instrument problem.

[37]Results for the loan and nominal interest rate regressions are similar, and available from the authors upon request.

VIX that represents risk aversion, and which is computed following Bekaert et al. (2013),[38] 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 2.

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 0.017, which is the average of the two elasticities in columns (4) and (5), 0.014 and 0.023, respectively.

In columns (6)-(9), we look at the pre-/post-crisis period for real and 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. The reason we study both nominal and real rates for pre- and post-crisis periods is the difference in results. There is no effect of VIX on real rates during the pre-crisis period, but during the post-crisis period VIX has a similar effect both on nominal and real rates. Meanwhile, during the pre-crisis period VIX only affects nominal rates. Our hypothesis for the difference in results for the pre/post-crisis periods for the effect of VIX on the real interest rate is that the first three years of pre-crisis period saw Turkey taming actual and expectation inflation, which fell dramatically and faster than nominal interest rates. Therefore, this period witnessed increased real rates on average, and their period-on-period changes due to the disinflation effect swamped the effect of changes in VIX, which still show up with the expected sign for the pre-crisis movements in nominal borrowing rates. Although we control for lagged quarter-on-quarter inflation, this variable does not pick up the full effect of the faster decline in expected inflation relative to nominal rates on real rates during the disinflation period.

Finally, columns (10)-(13) consider different bank samples, such as private banks and domestic banks. Results are similar across the different samples, with the exception that we estimate a lower elasticity of the real interest rate for the foreign bank sample.[39]

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

[39] This results points to the relative importance of domestic banks in transmitting the global financial cycle to the Turkish domestic credit market. Other papers focusing on the importance of international

We have also run robustness regressions where we alter our macro controls such as using expected changes in the exchange rate as opposed to actual changes. None of these tests alter our results.

4.3 Global Financial Conditions and Credit Constraints

We next explore how the effect of global financial conditions on the loan volume and borrowing costs differ with respect to banks' relative non-core funding, and how these interact with firm credit constraints and the currency composition of lending based on specifications (9)-(11). Given the inclusion of firm×quarter effects, the sample size will now drop as the regressions eliminate all firms that borrow only from one bank in a given quarter.[40]

Table 4 begins by presenting only the interaction between VIX and the dummy variable for banks' non-core liabilities, where the sample is split between high (= 1) and low (= 0) non-core banks. This dummy is based on the share of non-core liabilities to total liabilities. If a bank has a high share (high non-core group), this means that this banks' domestic deposit liabilities are low as a share of total liabilities and its international liabilities are high, again as a share of its total liabilities. We focus on results only for the loan and real interest rate regressions.[41]

First, looking at column (1) we find that banks with higher non-core liabilities respond more to movements in VIX in their loan issuances compared to the low non-core banks. This result matches that of Baskaya et al. (2016), who study the differential impact of capital inflows on loans for large and high non-core banks vis-à-vis small/low non-core ones, but without discriminating between the different currency composition of loans as we do here, and also without isolating the supply side of capital inflows. Next, turning to column (4), we provide a novel result on the differential impact of VIX on the interest rate for banks

bank linkages in the cross-border transmission of shocks include Peek and Rosengren (2000); Cetorelli and Goldberg (2011, 2012); Schnabl (2012); Claessens and van Horen (2013); de Haas and van Horen (2013); Kalemli-Özcan et al. (2013a,b); de Haas and van Leylveld (2014); Ongena et al. (2015); Cerutti et al. (2016).

[40]Note that firms that borrow in both FX and TL from only one bank in a given quarter will not be eliminated from these regressions. However, these case are rare, and the total number of additional observations we gain relative to the "multi-linked" firms of column (2) in Table 3 is only about one hundred thousand, or 1% more than the multi-linked sample.

[41]We also run regressions allowing for the slope on the trend variable to be heterogeneous across groups. The estimated coefficients for the interaction variables reported in Table 4 are similar in these specifications.

with a higher non-core ratio. We find these banks to be more responsive to changes in VIX, such that their lending rates are more procyclical – that is, during periods of high global risk appetite (i.e., low VIX), high non-core banks decrease their borrowing rates more in real terms (this result also holds when looking at nominal rather than real rates).

Table A11 further explores the potential impact of wealth effects of asset price changes on banks' lending behavior, arising from movements in VIX and/or the exchange rate, as highlighted in recent work of Bruno and Shin (2015a,b), the so-called "risk-taking channel". To do this, we run regressions that interact VIX or exchange rate changes with a dummy variable indicating whether a bank is a high or low capital bank. Or, correspondingly, whether a bank has low or high leverage. The regression specifications are otherwise identical to those in columns (1) and (4) Table 4. All regressions yield insignificant effects of the balance sheet mechanism, both for loans and real borrowing costs.

The estimated coefficient on the interaction between VIX and the non-core dummy is 0.015, which is almost as large as the estimated elasticity of 0.017 between the real interest rate and VIX in the macro regression (Table 2, column (3)). Therefore, the relative differential in changes in interest rates for high non-core banks given movement in global risk aversion is economically large.[42]

Next, columns (2) and (5) explore the interaction between banks' relative non-core positions and firm credit constraints by presenting results of regression (10) using the net worth dummy variable, where these regressions now also include bank×quarter effects. Notice that although banks and firms balance sheet strength will be endogenous to the equilibrium loan outcomes over time, by using non-core ratio and firm net worth as time-invarying dummy variables and further including firm×quarter and bank×quarter fixed effects in these triple interaction regressions, we solve this problem.

Our results are as follows. First, we find no statistical significance on the triple interaction term for loans in column (2). Interestingly, turning to column (5), we find a negative and

[42]We further run the interaction regression including VIX on its own and no firm×quarter effect in order to recover the VIX-only coefficient. In this case, the estimated coefficient on VIX is slightly lower (0.013) than the one in the macro regressions, while the coefficient on the interaction between the non-core dummy and VIX is almost the same (0.014) as in the regression with firm×quarter effects. Given this regression, the estimated real interest rate-VIX elasticity for high non-core banks is double ($0.013 + 0.014 = 0.027$) that of low non-core banks (0.013).

significant coefficient. Given the positive coefficient on the non-core interaction on its own in the real interest rate regression of column (4), this negative coefficient on the triple interaction in column (5) implies that in periods of high global risk appetite, high non-core banks lower rates relatively more for low net worth firms. Given the insignificant coefficient in the loan regression in column (2), there is no differential in the supply of loans from high non-core banks to low and high net worth firms as VIX varies. If we remove firm×quarter fixed effects in column (2), we can now estimate whether low net worth firms borrow relatively more than high net worth firms during episodes of low VIX. We found that this is indeed the case, however, when it comes to the triple interaction, there is still not a significant difference between low and high net worth firms in loan outcomes when VIX goes down.[43] We further explore why low net worth firms do not borrow relatively more than high net worth firms, even though their real borrowing costs fall relatively more during periods of low VIX in Section 4.4, using loan-level data in order to examine the possibility of collateral constraints at the loan level that bind for low net worth firms.

If we combine the coefficient on the double and triple interactions for the real interest rate in columns (4) and (5), 0.015 and −0.005, respectively, we see that the that the elasticity of the real interest rate visà-vis VIX is approximately 0.01 when high non-core banks lend to high net worth firms, versus a value of 0.015 if high non-core banks lend to low net worth firms. In other words, the elasticity is roughly 50% larger for high non-core banks lending to low net worth firms relative to if they lend to high net worth firms. We, then run the triple interaction regression without firm×quarter and bank×quarter effects in order to recover the coefficient on VIX on its own, as well as the interaction with both VIX and the non-core and net worth dummies. In this regression, the coefficient on the interaction between non-core and VIX is 0.011, and the coefficient on the triple interaction is −0.004. These coefficient are comparable to those reported in Table 4 with the fixed effects, and imply that the real interest rate elasticity viz. VIX is roughly 57% larger for high non-core banks lending to low net worth firms relative to if they lend to high net worth firms.

To gauge the importance of the FX denominated loans, columns (3) and (6) present the results studying the potential heterogeneous effects of global liquidity on the foreign currency

[43]Removing bank×quarter effects do not alter the results.

denomination of loans and interest rates. In particular, we interact the VIX with an FX dummy and non-core dummy, instead of the net worth of firms. First, as column (3) shows, there appears to be no differential in the volume of FX and TL loans issued by high non-core banks over the cycle. It is interesting to note this fact since the conventional wisdom is that internationally borrowing banks extend more foreign currency loans domestically, and firms who are in the tradeable sector demand such loans more, during booms. Recall that we control for time-varying firm effects exactly to control for such effects of an increase in FX loans during boom periods, since exporters might be more likely to demand such loans. In fact, when we remove the firm×quarter effects from this regression, we do find that banks with higher non-core liabilities do lend more in FX.

However, turning to the interest rate regression of column (6), we do find a differential in the relative interest rates in spite of controlling for both bank and firm time varying factors. In particular, high non-core banks tend to lower the TL borrowing rate relatively more than the FX ones when VIX is low. This result is novel and is in line with our theoretical framework where the differential between FX and TL rates goes down (TL borrowing becomes relatively cheaper) as a result of a decrease in country risk premium which is triggered by a fall in VIX. Removing firm×quarter effects and/or bank×quarter effects do not alter any of the results of the interest rate regressions, which confirms the generality of these results.

4.4 Loan-Level Evidence for Collateral Constraints

So far we have used data collapsed at the firm-bank pair level over time. We have argued that cheaper borrowing, as a result of lower global risk and resulting capital inflows, is the key reason for the increase in domestic credit growth. However, we have also showed heterogenous results in a difference-in-difference framework, where low net worth firms borrowing from banks with a higher ratio of non-core liabilities face a larger decline in real borrowing costs, but their borrowing does not increase relatively more than high net worth firms. We investigate the possibility that collateral constraints may play a role in this observed relationship in this section using data on *new* loan issuances.

We estimate a loan-level version, l, of our previous estimation equations where we condition on the collateral, and hence riskiness, of each loan, and its interaction with VIX; that is:

$$\log \mathrm{Y}_{f,b,l,m} = \omega_{f,b,m} + \beta_1 \mathrm{Collateral}_{f,b,l,m} + \beta_2(\mathrm{Collateral}_{f,b,l,m} \times \log \mathrm{VIX}_{m-1}) + \beta_3 \mathrm{FX}_{f,b,l,m} + e_{f,b,l,m}, \quad (12)$$

where we change the q subscript to m for variables that vary at a monthly level, and focus on both loan amount and the real interest rate as the endogenous variables. $\omega_{f,b,m}$ 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. We proxy for time-varying loan level risk by including $\mathrm{Collateral}_{f,b,l,m}$, which measures the collateral-to-loan ratio. Note that we use the ratio rather than the level of collateral given the large heterogeneity in observed loan size. We prefer to use the collateral ratio since this is a revealed outcome in terms of loan risk.[44] Finally, $\mathrm{FX}_{f,b,l,m}$ is a dummy variable (0 = TL, 1 = FX) that captures the currency denomination risk of the loan as given by the same term in our framework.

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 amounts 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.[45]

Table 5 presents results for regression (12), where we examine specifications with either (i) month fixed effects only, (ii) firm×month effects, and finally (iii) firm×bank×month effects, in moving from left to right for the loan and real interest rate regressions. First, looking at the results for loans in columns (1)-(3), the collateral-to-loan ratio is positive and significant, indicating collateral constraints exist at the loan level. This result is there regardless of which fixed effects are used, meaning loan level collateral constraints are independent of firm and bank characteristics and more general. Importantly, this result remains significant in column

[44] We also tried using subjective bank-assigned risk weights to loans. Loans are put into risk weight bins by loan officers. These risk weights for loans are determined by the Basel committee.

[45] Recall that the collateral-to-loan ratio can be greater than one. We therefore winsorize the collateral-to-loan ratio at the 5% level. Results are also robust if we truncate the data at collateral-to-loan ratio equal to 200%.

(3), which include the most stringent set of fixed effects, which capture, among other factors, the interaction between banks' non-core and firms net worth positions and identifies from new loans within a given bank-firm pair over time.

Next, turning to the interaction between the collateral ratio and VIX, again focusing on columns (1)-(3), the coefficient is positive and significant in all specifications. This indicates that the positive relation between collateral ratio and loan amounts and hence the loan-level collateral constraints get stronger during episodes of increased global risk (or relation gets weaker when global risk and hence VIX goes down, where both variables in the interaction term are demeaned). Notice that this result is there regardless of controlling unobserved time-varying firm and bank heterogeneity, meaning global risk correlates one-to-one with loan level risk.

Columns (4)-(6) present consistent results for real interest rates. Like the loans' regressions, the collateral ratio is significant, and has the expected sign, that is a negative relation between the collateral ratio and its price. During low VIX periods this relation relaxes, that is to obtain a lower interest rate, less collateral can be posted during low VIX. However, this interacted coefficient of VIX and the collateral ratio loses significance when including firm×month and firm×bank×month fixed effects, in columns (5) and (6). In other words, once we control for the unobserved time-varying firm characteristics, such as time-varying firm risk, then loan level interest rate does not respond to global risk.

Overall, we interpret these findings as additional evidence for our main results. During times of low global risk and high global liquidity, foreign investors and banks might assign lower risk to some of the risky firms and offer them lower interest rates. However, collateral constraints at the loan level still prevent some of these firms from borrowing even they can finance their borrowing at a lower cost.

Table A12 further investigates the possibility that exchange rate movements have a role different than VIX in impacting lending behavior by loosening collateral constraints. This mechanism works via the existence of too much dollar debt on firms' balance sheets, where an appreciation of the exchange rate via capital inflows constitutes a positive balance sheet shock for those firms.[46] The estimated coefficients on the interaction between the collateral

[46] Recall that we have investigated the effect of such "risk-taking" channel on banks' balance sheets, where

ratio and exchange rate changes are insignificant for both loans and interest rates, and hence not provide support for the mechanism where borrowers can borrow more as a result of a positive balance sheet shock via exchange rate appreciation.[47]

5 Conclusion

This paper exploits a unique firm-bank-loan-month-level dataset for a major emerging economy to study the impact of capital inflows on domestic credit growth. Our estimation strategy allows us to identify an important role for supply-side driven capital flows in reducing the borrowing costs faced by firms, and expanding the volume of corporate credit. Instrumenting capital flows by VIX, we can isolate the role of exogenous capital flows on domestic credit. Our supply-side estimates explain 40% of the observed average cyclical credit growth of the aggregate corporate sector. The elasticity of the interest rate with respect to capital flow is much larger when we isolate the supply-side drivers of capital inflows compared to the elasticity when capital flows are driven both by demand and supply side factors since the effects of both factors on the interest rate are in opposite directions. Banks that rely more on non-core funding are influential on our results. Such banks pass to firms, especially to low net worth and small firms, lower borrowing costs as a result of the easing of international financial conditions.

The results in this paper highlight important empirical facts that policy makers in emerging markets must confront when dealing with the impact of international spillovers. In particular, when monetary conditions in other countries are loose and/or global risk appetite is high, emerging markets will receive capital inflows and these flows substantially impact domestic credit conditions. As argued by Mishra and Rajan (2016), international spillovers may be good or bad for a country given the balance between demand switching effects of exchange rate changes (home country and abroad) versus demand creating effects of increased credit availability for investment. In such an environment, raising the policy rate might help

banks hit by a positive balance sheet shock via the changes in the value of their capital due to changes in the exchange rate in Table A11 following the work of Bruno and Shin (2015a,b).

[47]Regressions interacting the collateral ratio with a dummy indicating a depreciation or not in a given (lagged) quarter give similar results to those reported in Table A12, and are available from the authors upon request.

to slow down domestic credit expansion, and hence prevent asset price bubbles from forming. At the same time, a higher interest rate might attract more capital flows fueling further local credit expansion and lead to a loss in international competitiveness via an appreciating currency.[48] Given this dilemma, most emerging market policy makers opt for the use of macroprudential policies instead of employing policy rates.

Our results imply that capital flows transfers global conditions to the emerging markets in terms of lower real borrowing costs. All our results are conditional on changes in the policy rates and exchange rates and hence they show the potential limitations to the effectiveness of monetary policy in the context of a global financial cycle, indicating a "financial trilemma": that is the task of achieving financial stability is hard under national financial regulation, free capital flows, and a global financial cycle, regardless of the exchange rate regime (Obstfeld, 2015).

[48]As argued by Blanchard et al. (2015), exogenous capital inflows leading to an expansion in output and credit is a phenomenon that cannot be explained by the standard models due to a decline in net exports at a given policy rate. These authors present a model with an extended set of assets, where in the presence of financial frictions, capital inflows can reduce the cost of financial intermediation, leading to a credit boom and an output increase.

Appendix A Regression Details

A.1 Instrumental Variables' Two-Stage Regression Strategy

We estimate the instrumental regression for (7) 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 (7) with bank×firm fixed effects. The first-stage estimation equation for quarter q is then:

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

where we use the predicted values for capital inflows at $q-1$ in the second-stage of (7). Note that there is a small difference in notation however, where given the inclusion of the exogenous bank variables in (A.1), the predicted capital inflows measure may differ due to the cross-sectional difference of the bank variables at time q.[49] In particular, the capital inflows measure is repeated for each bank b in a given quarter q.

A.2 LATE in Instrumental Variable Regressions

Although we believe that the key reason for having higher IV coefficients is the demand effect as we explained above, it is also possible that we estimate a local average treatment effect (Imbens and Angrist, 1994) In particular, the regression estimates based on VIX-driven capital inflows may differ for small versus large loans and their interest rates because the effect of capital inflows differs for large versus small banks' credit supply (and hence the loans they provide), which is relevant given the observed heterogeneity of bank size in

[49] Omitting the FX dummy in (A.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.

our data. We outline our interpretation of this case as follows. Assume that there are two equally large groups of banks, which are differentially impacted by capital inflows. For banks (b) belonging to group j ($j = 1, 2$), the impact of VIX on capital inflows, Kf, (in logs) is $\log \mathrm{Kf}^j_{b,t} = d_j \log \mathrm{VIX}^j_{b,t} + v^j_{b,t}$. Banks in group 1, where d_1 is large, are banks which are more likely to receive more capital inflows. Under regularity conditions in large samples, the first-stage WLS estimate from a regression using the combined sample is $\Delta \log \mathrm{Kf} = \frac{d_1+d_2}{2} \Delta \log \mathrm{VIX}$. Consider also that the impact of capital inflows differs between groups for the interest rate: $\log(1 + i_{b,t}) = \beta_j \log \mathrm{Kf}^j_{b,t} + e_{b,t}$. An IV regression of $\log(1 + i)$ on $\log \mathrm{Kf}$, using our instrument VIX, gives, in large samples, the coefficient $\frac{d_1\beta_1+d_2\beta_2}{d_1+d_2}$; that is, a weighted average of β_1 and β_2. Relatively larger coefficients d_1 and β_1 imply that the IV estimate is larger than the OLS estimate, which gives equal weight to β_1 and β_2. As we show in Baskaya et al. (2016), it is indeed the case that larger banks are more procyclical during capital inflow episodes by providing more loans at cheaper rates during episodes of high capital inflows.

A.3 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 (8) as

$$\log(\widehat{\mathrm{Loan}}_{f,b,d,q}) = \widehat{\widehat{\beta}} \log(\mathrm{VIX}_{q-1}), \tag{A.2}$$

where $\widehat{\beta}$ is the estimated coefficient. First, differentiate both sides of (A.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

$$w_{f,b,d,q-1} \mathrm{d}\log(\widehat{\mathrm{Loan}}_{f,b,d,q}) = w_{f,b,d,q-1} \widehat{\widehat{\beta}} \mathrm{d} \log(\mathrm{VIX}_{q-1}), \tag{A.3}$$

so,

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

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

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

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

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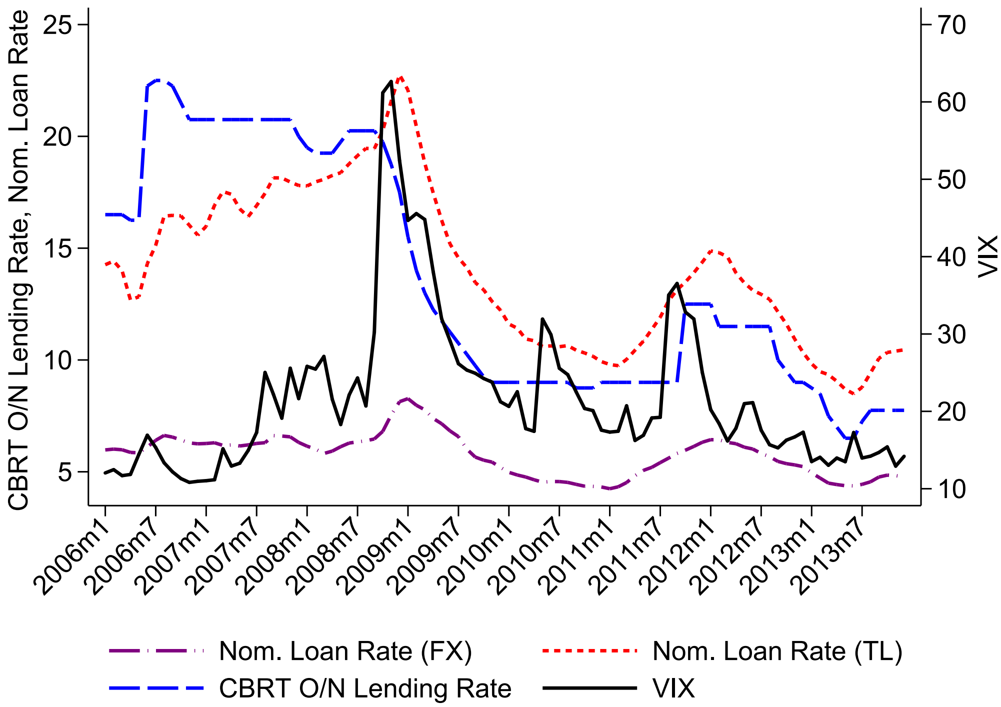
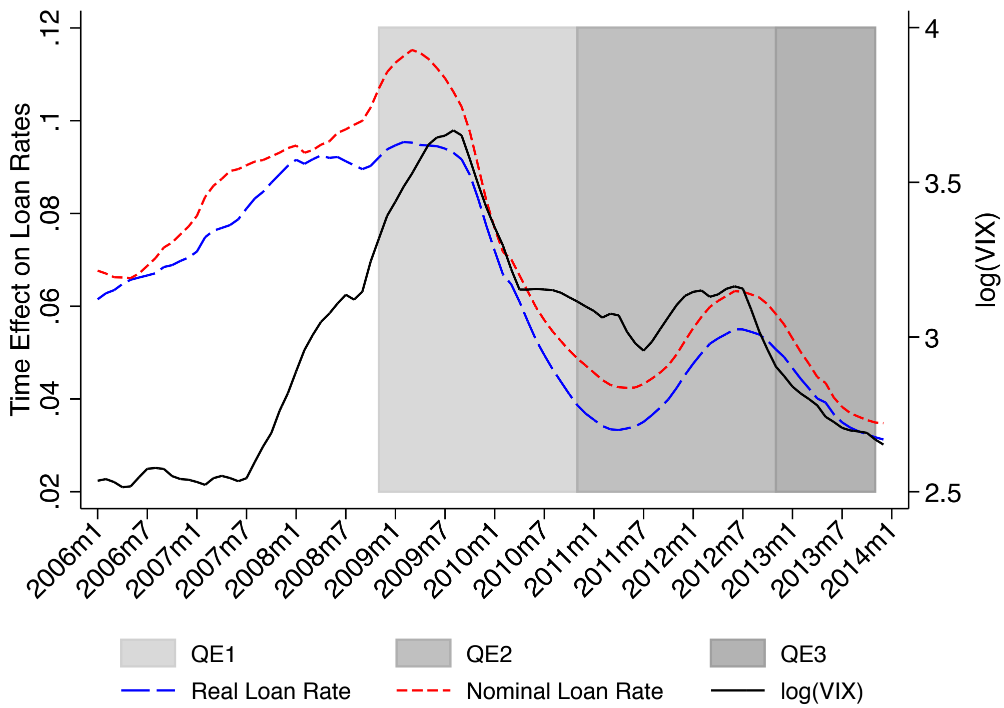
Figure 1. Central Bank Policy Rates, Borrowing Costs and VIX, 2003–13



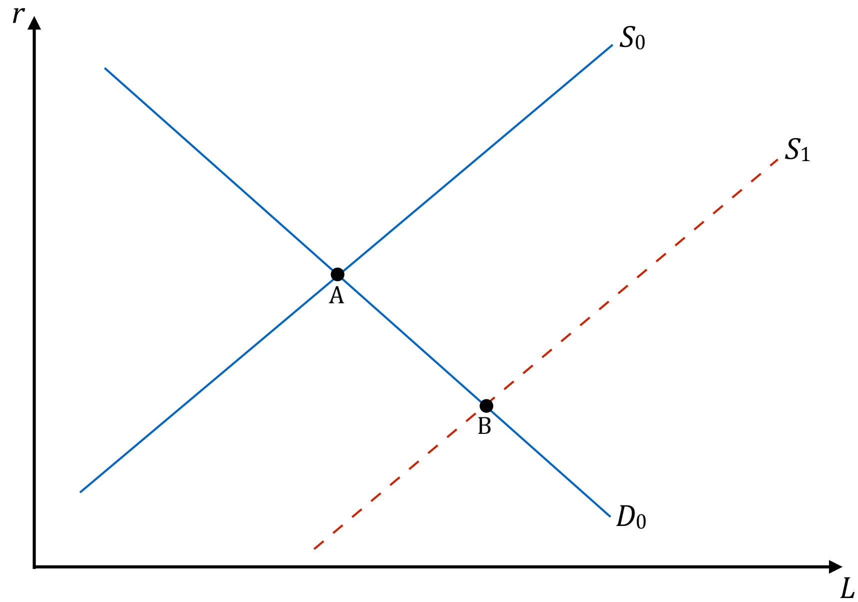
Notes: This figure plots nominal interest rates in Turkey (in percentage terms) along with VIX over 2003–13 at a monthly level. 'CBRT O/N Lending Rate' is the nominal interest rate at which the CBRT lends at overnight maturity to the banks who are in liquidity-need. 'Nom. Loan Rate (TL)' is the weighted average value of nominal interest rates on the TL-denominated loans in our loan data. 'Nom. Loan Rate (FX)' is the weighted average value of nominal interest rates on the FX-denominated loans in our loan data. 'VIX' is the end-of-month VIX. Source: CBRT.

Figure 2. Time Effects on Real and Nominal Borrowing Costs and VIX, 2003–13

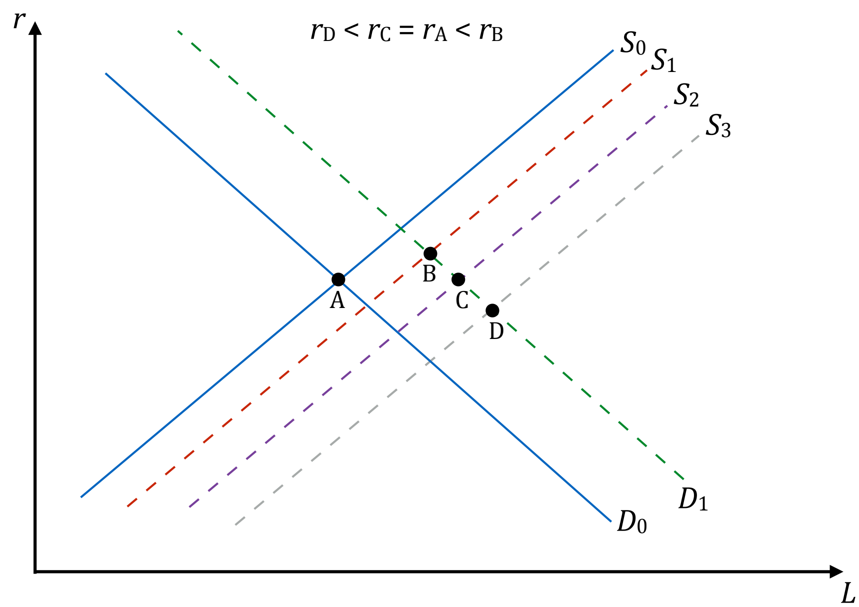


Notes: This figure plots time effects on nominal and real loan rates in Turkey along with VIX over 2003–13 at a monthly level. The time (month) effects are obtained from a regression of loan level rates on bank×firm and month fixed effects controlling several time-varying loan characteristics such as collateral, maturity, currency and riskiness. We normalize the time effects by adding the absolute value of the minimum of the series to all value in the series. Source: CBRT.

Figure 3. Supply and Demand Shocks to Credit Market: Relative impacts

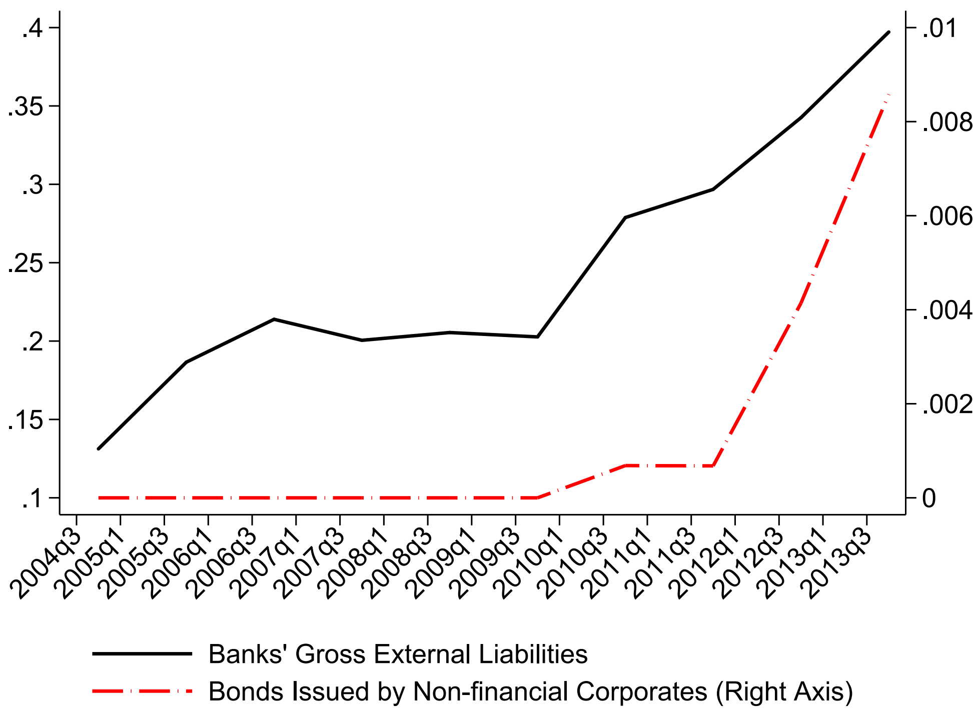


(a) Supply shock



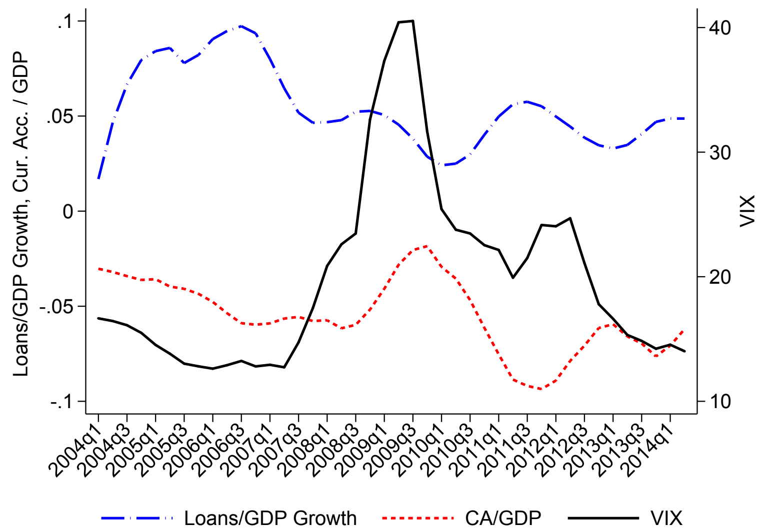
(b) Supply and Demand shocks

Figure 4. Banks and Firms External Borrowing, 2003–13

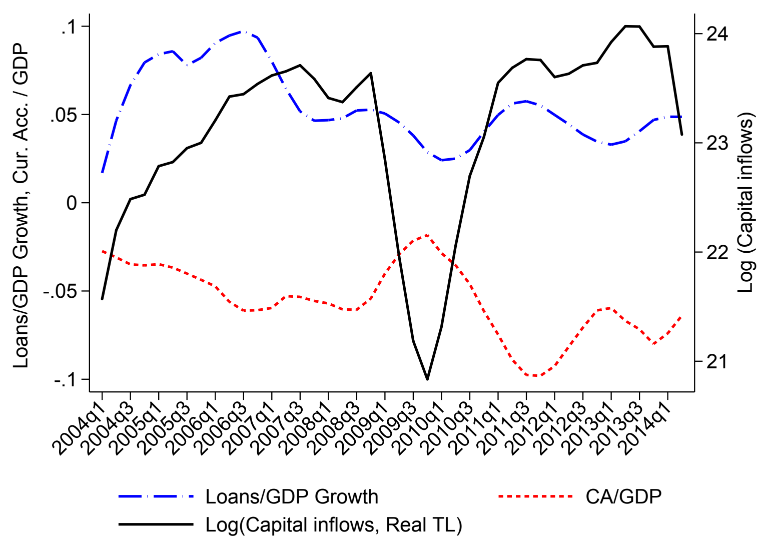


Notes: This figure plots the external liabilities of banks and external corporate bond issuance as a ratio to GDP. Source: CBRT.

Figure 5. Capital Flows, VIX, and Credit Growth in Turkey, 2003–13



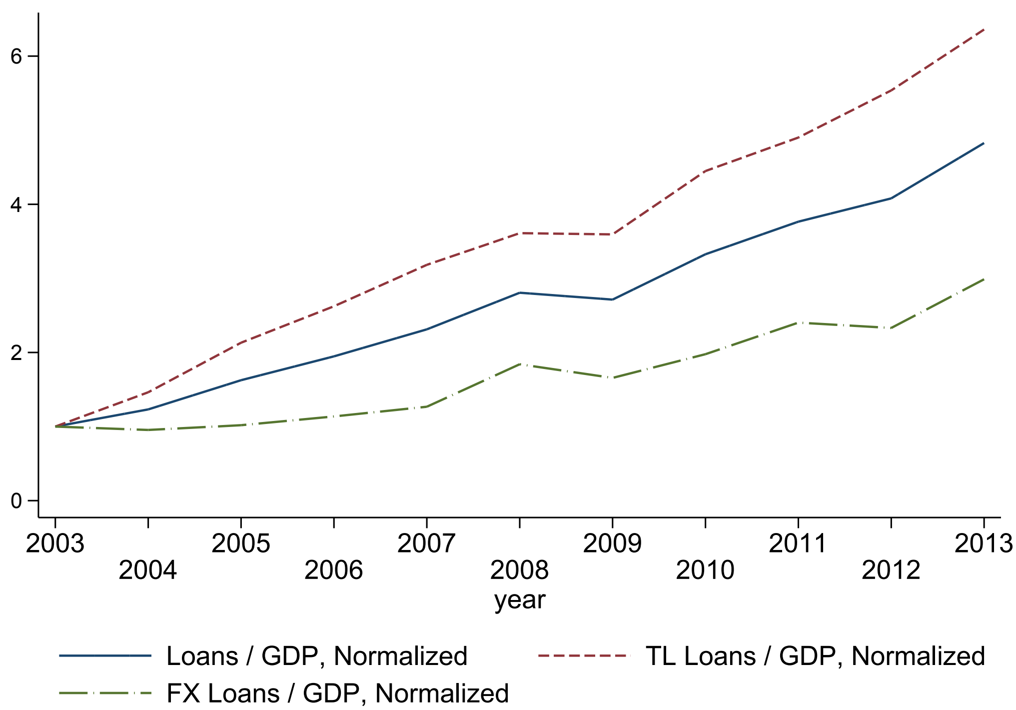
(a) VIX



(b) Capital Inflows

Notes: These figures plot Turkey's Loans/GDP and CA/GDP ratios over time with (a) 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.

Figure 6. Loan Growth, 2003–13



Notes: This figure plots the end of year ratio of total outstanding loans reported in balance sheets of Turkish banks to Turkish GDP, where each year's ratio is normalized with the ratio for the first year of sample, 2003. 'Loans/GDP' is for total loans, while 'TL Loans/GDP' and 'FX Loans/GDP' are ratios for loans denominated in Turkish lira and foreign currency, respectively. Source: CBRT.

Table 1. Capital Flows, Loans, and Interest Rates: OLS and IV Estimates, 2003–13

Panel A. OLS and Second-stage of IV

	$\log(\text{Loans}_q)$		$\log(1+i_q)$		$\log(1+r_q)$	
	OLS (1)	IV (2)	OLS (3)	IV (4)	OLS (5)	IV (6)
$\log(\text{K Inflows}_{q-1})$	0.040^a	0.040^b	-0.005^a	-0.011^a	-0.005^b	-0.009^a
	(0.006)	(0.017)	(0.001)	(0.001)	(0.002)	(0.003)
FX	0.645^a	0.645^a	-0.070^a	-0.070^a	-0.078^a	-0.078^a
	(0.012)	(0.012)	(0.003)	(0.003)	(0.003)	(0.003)
Policy rate$_{q-1}$	-0.078	0.153	0.231^a	0.197^a	0.046	0.015
	(0.262)	(0.320)	(0.022)	(0.024)	(0.059)	(0.054)
Observations	19,982,267	19,982,267	19,982,267	19,982,267	19,982,267	19,982,267
R-squared	0.850	0.850	0.791	0.793	0.778	0.779
Bank×firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Macro controls & trend	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes

Panel B. First-stage of IV: $\log(\text{K inflows}_q)$ Regression

$\log(\text{VIX}_{q-1})$	Observations	R-squared	F-stat
-1.694^a	1,685	0.571	16.35
(0.419)			

Notes: This table presents results for the OLS and IV regressions for (7) using quarterly data for all loans in Panel A. Columns (1) and (2) use the natural logarithm of total loans between a firm-bank as the dependent variable; columns (3) and (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 columns (5) and (6) use the natural logarithm of the weighted average of the real interest rates for loans between a firm-bank as the dependent variable. The 'K Inflows' variable is real quarterly gross capital inflows into Turkey, the policy rate is the quarterly average overnight rate, and FX is a 0/1 dummy indicating whether a loan is in foreign currency (= 1) or domestic (= 0). Lagged Turkish real GDP growth, inflation, Turkish lira/US dollar exchange rate change, and a linear time trend are included (not shown) as regressors. Furthermore, the following 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.

Panel B presents the first-stage regression for the IV, which is run at the bank×quarter level for the whole sample period. The first-stage 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.

Table 2. VIX, Loans, and Interest Rates: OLS Estimates, 2003–13

	$\log(\text{Loans}_q)$	$\log(1{+}i_q)$	$\log(1{+}r_q)$
	(1)	(2)	(3)
$\log(\text{VIX}_{q-1})$	-0.067[b]	0.019[a]	0.017[a]
	(0.029)	(0.003)	(0.004)
FX	0.645[a]	-0.070[a]	-0.078[a]
	(0.012)	(0.003)	(0.003)
Policy rate_{q-1}	0.127	0.204[a]	0.021
	(0.323)	(0.024)	(0.053)
Observations	19,982,267	19,982,267	19,982,267
R-squared	0.850	0.793	0.779
Bank×firm F.E.	Yes	Yes	Yes
Macro controls & trend	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes

Notes: This table presents results for the regressions (8) using quarterly data for all loans. Column (1) use the natural logarithm of total loans between a firm-bank as the dependent variable, and columns (2) and (3) use the natural logarithm of the weighted average of the nominal and real interest rates, respectively, for loans between a firm-bank as the dependent variable. VIX and the policy rate are quarterly averages, and FX is a 0/1 dummy indicating whether a loan is in foreign currency (= 1) or domestic (= 0). Lagged Turkish real GDP growth, inflation, Turkish lira/US dollar exchange rate change, and a linear time trend are included (not shown) as regressors. Furthermore, the following 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. 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.

Table 3. VIX and Interest Rates: OLS Robustness Estimates, 2003–13

	Whole Sample		*Multi-Bank*	*Maturity*	
	Firm×year F.E.	Risk Aversion	*Links*	Short	Long
	$\log(1+r_q)$		$\log(1+r_q)$	$\log(1+r_q)$	
	(1)	(2)	(3)	(4)	(5)
$\log(\text{VIX}_{q-1})$	0.018^a	0.007^b	0.018^a	0.014^a	0.023^a
	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Observations	19,173,132	19,982,267	9,176,769	9,891,414	9,758,665
R-squared	0.874	0.778	0.750	0.798	0.836

	Crisis Period			
	Pre	Post	Pre	Post
	$\log(1+r_q)$		$\log(1+i_q)$	
	(6)	(7)	(8)	(9)
$\log(\text{VIX}_{q-1})$	-0.003	0.025^a	0.039^a	0.022^a
	(0.005)	(0.005)	(0.008)	(0.004)
Observations	4,293,517	14,626,000	4,293,517	14,626,000
R-squared	0.771	0.858	0.773	0.868

	Bank Type			
	Priviate	Private + State	Domestic	Foreign
	$\log(1+r_q)$			
	(10)	(11)	(12)	(13)
$\log(\text{VIX}_{q-1})$	0.023^a	0.017^a	0.019^a	0.009^b
	(0.004)	(0.004)	(0.005)	(0.004)
Observations	13,376,195	19,922,760	14,514,150	5,440,975
R-squared	0.784	0.779	0.706	0.857

Notes: This table presents robustness results for the regressions (8) using quarterly data for all loans. Columns (1)-(7) and (10)-(13) use the natural logarithm of the weighted average of the real interest rates for loans between a firm-bank as the dependent variable, and and columns (8) and (9) use the natural logarithm of the weighted average of the nominal interest rates for loans between a firm-bank as the dependent variable. VIX is the quarterly average. All specifications include the FX 0/1 dummy indicating whether a loan is in foreign currency (= 1) or domestic (= 0); lagged Turkish real GDP growth, inflation, Turkish lira/US dollar exchange rate change, policy rate, and a linear time trend (except column (1)). Furthermore, the following 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). Finally, bank×firm fixed effects are also included. Column (1) includes firm×year effects for the the whole sample; column (2) uses the "risk aversion" component of VIX (rather than total VIX), which is extracted following Bekaert et al. (2013); column (3) only includes firms that borrow from multiple banks in a given quarter; columns (4) and (5) split the sample by maturity type; columns (6)-(9) look at the pre-/post-crisis period for real and nominal rates; columns (10)-(13) consider different bank samples. Regressions are all weighted-least square, where weights are equal to the loan share. 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.

Table 4. VIX's Spillovers via Banks, Firms, and Currency Denomination: OLS Estimates, 2003–13

	log(Loans_q)			log($1+r_q$)		
	(1)	(2)	(3)	(4)	(5)	(6)
log(VIX_{q-1})×Noncore_b	-0.035[b]			0.015[a]		
	(0.017)			(0.004)		
log(VIX_{q-1})×Noncore_b×NetWorth_f		-0.0004			-0.005[a]	
		(0.021)			(0.001)	
log(VIX_{q-1})×Noncore_b×FX			-0.007			-0.012[a]
			(0.018)			(0.004)
FX	0.690[a]	0.806[a]	0.745[a]	-0.079[a]	-0.076[a]	-0.042[c]
	(0.013)	(0.019)	(0.095)	(0.003)	(0.004)	(0.021)
Observations	9,280,825	1,240,310	9,280,825	9,280,825	1,240,310	9,280,825
R-squared	0.876	0.763	0.877	0.852	0.812	0.877
Bank×firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	No	No	Yes	No	No
Firm×quarter F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Bank×quarter F.E.	No	Yes	Yes	No	Yes	Yes

Notes: This table presents results for the regressions (9), (10), and (11) using quarterly data for all loans. Columns (1)-(4) use the natural logarithm of total loans between a firm-bank as the dependent variable, and columns (5)-(8) use the natural logarithm of the weighted average of the and real interest rates for loans between a firm-bank as the dependent variable. Columns (1) and (4) present the double interaction from regression (9); column (2), (3) and (5), (6) the triple interaction from regression (10), and columns (4) and (8) the triple interaction from regression (11). FX is a 0/1 dummy indicating whether a loan is in foreign currency (= 1) or domestic (= 0). The lagged values of the following bank-level characteristics are also controlled for in columns (1) and (4) (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. 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.

Table 5. VIX, Loans and Real Interest Rates at Loan Origination: OLS Estimates, 2003–13

	$\log(\text{Loans}_m)$			$\log(1{+}r_m)$		
	(1)	(2)	(3)	(4)	(5)	(6)
Collateral/Loan	0.102[a]	0.088[a]	0.092[a]	-0.002[c]	-0.004[a]	-0.003[a]
	(0.005)	(0.010)	(0.012)	(0.001)	(0.001)	(0.001)
Collateral/Loan×log(VIX_{m-1})	0.015[c]	0.028[b]	0.034[b]	-0.003[a]	0.001	0.001
	(0.009)	(0.011)	(0.015)	(0.001)	(0.001)	(0.002)
FX	0.409[a]	0.454[a]	0.511[a]	-0.081[a]	-0.077[a]	-0.077[a]
	(0.020)	(0.037)	(0.043)	(0.003)	(0.003)	(0.005)
Observations	18,239,721	13,043,273	11,311,762	18,239,721	13,043,273	11,311,762
R-squared	0.731	0.833	0.845	0.646	0.832	0.855
Bank×firm F.E.	Yes	Yes	No	Yes	Yes	No
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Risk F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Maturity F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	No	No	Yes	No	No
Firm×month F.E.	No	Yes	No	No	Yes	No
Bank×firm×month F.E.	No	No	Yes	No	No	Yes

Notes: This table presents results for regressions using monthly data at the loan level. All variables are measured at the loan level, where 'Collateral/Loan' ratio is the collateral-to-loan ratio, and 'FX' is a dummy variable indicating whether the loan is in foreign currency (= 1) or Turkish lira (= 0). The regressions further include (i) bank defined risk weights, (ii) sectoral activity, and (iii) maturity levels. Columns (1)-(3) presents results for the natural logarithm of loan value, and columns (4)-(6) for the real interest rate. Columns (1) and (4) control for monthly fixed effects; columns (2) and (5) control for firm×month fixed effects; and columns (3) and (6) control for firm×bank×month fixed effects. 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.

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. Credit Register FX Breakdown, 2003–13

Panel A. Universe of Corporate Loans

	(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

Panel B. Sample with Matched Firm Balance Sheet Data

	(1)	(2)	(3)
	Share of FX Loans in All Loans		
	Overall	In FX	FX-Indexed
2003	0.742	0.719	0.023
2004	0.718	0.694	0.024
2005	0.688	0.619	0.069
2006	0.658	0.591	0.067
2007	0.654	0.565	0.089
2008	0.695	0.626	0.069
2009	0.661	0.595	0.066
2010	0.645	0.551	0.093
2011	0.680	0.584	0.096
2012	0.641	0.541	0.100
2013	0.671	0.569	0.102

Notes: This table presents annual summary statistics of the credit register coverage of loans, over the 2003–13 period, using end-of-year data. Panel A presents summaries for all loans in the dataset, while Panel B presents statistics based on loans for the sample that includes loans for firm-bank pairs where the firms also have usable balance sheet data (i.e., for the matched credit register and firm-level datasets). 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 A2. Credit Register Sample Coverage of Firm-Bank Relationships, 2003–13

Panel A: All Firms

	(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

Panel B: Matched Firms

	(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	34	3,718	1,882	5,677	0.751	0.798	3.092
2004	34	4,439	1,795	8,918	0.832	0.847	3.373
2005	34	5,151	1,858	11,489	0.861	0.862	3.489
2006	36	5,296	1,459	15,348	0.913	0.89	4.000
2007	35	6,248	1,627	19,883	0.924	0.88	4.303
2008	35	7,631	2,061	23,419	0.919	0.882	4.204
2009	34	8,512	2,362	24,992	0.914	0.886	4.064
2010	38	10,614	2,430	38,239	0.940	0.906	4.672
2011	40	11,382	2,399	45,748	0.950	0.915	5.093
2012	39	10,999	2,096	47,534	0.958	0.919	5.339
2013	41	9,458	1,763	41,897	0.960	0.918	5.445

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. Panel A presents summaries for all loans in the dataset, while Panel B presents statistics based on loans for the sample that includes loans for firm-bank pairs where the firms also have usable balance sheet data (i.e., for the matched credit register and firm-level datasets). 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 A3. 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
Collateral/Loan	19,982,267	1.816	1.000	2.866	0.000	20.89
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
Collateral/Loan	18,714,102	1.857	1.000	2.906	0.000	20.89
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
Collateral/Loan	1,268,165	1.200	1.000	2.115	0.000	20.89
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; 'Collateral/Loan' is the ratio of the total collateral to total principal outstanding for a firm-bank pair; '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 A4. 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 tables 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 A5. 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
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 A6. Firm Database Coverage, 2003–12

Year	Gross Output
2003	0.45
2004	0.33
2005	0.34
2006	0.38
2007	0.40
2008	0.47
2009	0.50
2010	0.50
2011	0.49
2012	0.45

Notes: This table compares our cleaned sample with the Annual Industry and Service Statistics collected by the Turkish Statistical Institute (Turkstat) over the 2003-12 period. The column 'Gross Output' measures the total of the sales of goods and services invoiced by the observation unit during the reference period in our dataset relative to the same number reported in Turkstat for a broader and representative set of firms.

Table A7. Firm Database Coverage: Breakdown by Firm Employee-Size Distribution, 2012

		Gross Output	
	Strata	All Sectors	Mfg. Sector
Sample	1-19 employees	0.053	0.013
	20-249 employees	0.304	0.235
	250+ employees	0.642	0.752
TurkStat	1-19 employees	0.270	0.095
	20-249 employees	0.364	0.361
	250+ employees	0.367	0.544

Notes: This table compares our cleaned sample with the Annual Industry and Service Statistics collected by the Turkish Statistical Institute (Turkstat) broken down by firm size (employees) for 2012. The column 'Gross Output' measures the total of the sales of goods and services invoiced by the observation unit during the reference period in our dataset relative to the same number reported in Turkstat for a broader and a representative set of firms.

Table A8. Firm-Level Annual Summary Statistics, All Firms, 2003–13

Panel A. All Sectors excluding Finance and Government

	Obs.	Mean	Median	Std. Dev.	Min.	Max.
Log(Assets)	71,034	4.518	4.430	1.513	-5.612	12.01
Net Worth	71,034	3.761	3.737	1.728	-5.992	11.77

Panel B. Manufacturing Sector

	Obs.	Mean	Median	Std. Dev.	Min.	Max.
Log(Assets)	33,346	4.667	4.557	1.472	-3.055	11.15
Net Worth	33,346	4.022	3.974	1.701	-4.402	10.94

Notes: This table presents summary statistics using firm balance sheet and income statement data are sourced from a supervisory dataset that is collected by the CBRT annually. Panel A presents statistics for firms in all sectors of the economy, excluding the financial and governmental sectors; Panel B presents statistics for only firms in the manufacturing sectors. All levels are in real thousands of TL, and the base year is 2003.

Table A9. Turkish and World 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	0.022	0.017	-0.059	0.048
Inflation (q-o-q)	44	0.022	0.017	0.017	0.006	-0.003	0.080
Δ log(TL/US$) (q-o-q)	44	0.006	0.001	0.058	0.066	-0.104	0.271
CBRT overnight rate	44	0.188	0.182	0.118	0.113	0.067	0.517
Expected annual inflation (y-on-y)	44	0.088	0.07	0.017	0.049	0.055	0.264
CA/GDP	44	-5.144	-5.379	2.227	3.630	-9.803	-1.303
log(Capital inflows)	44	18.25	18.61	0.730	0.926	15.92	19.22
log(VIX)	44	2.957	2.912	0.368	0.566	2.401	4.071
US 10-year/3-month spread	44	0.020	0.023	0.016	0.012	-0.004	0.036

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 exchange rate change viz. the US dollar are all quarter-on-quarter; while expected inflation, which is used to calculate real rates, is year-on-year. The VIX, CBRT overnight rate and the US 10-year note/3-month T-bill spread 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 A10. Capital Flows, Loans, and Interest Rates: IV with Overidentifying Restrictions, 2003–13

Panel A. Second-stage of IV

	$\log(\text{Loans}_q)$	$\log(1{+}i_q)$	$\log(1{+}r_q)$
	IV	IV	IV
	(1)	(2)	(3)
$\log(\text{K Inflows}_{q-1})$	0.059^a	-0.011^a	-0.007^c
	(0.018)	(0.002)	(0.003)
FX	0.644^a	-0.070^a	-0.078^a
	(0.012)	(0.003)	(0.003)
Overnight rate_{q-1}	0.030	0.223^a	0.032
	(0.292)	(0.023)	(0.056)
Observations	19,982,267	19,982,267	19,982,267
R-squared	0.850	0.793	0.778
Bank×firm F.E.	Yes	Yes	Yes
Macro controls & trend	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes

Panel B. First-stage of IV: $\log(\text{K inflows}_q)$ Regression

	$\log(\text{VIX}_{q-1})$	US Spread_{q-1}	Observations
	-1.332^a	-19.73^a	1,685
	(0.477)	(6.990)	
	R-squared	F-stat	
	0.611	20.63	

Notes: This table presents results for the OLS and IV regressions for (7) using quarterly data for all loans in Panel A. Columns (1) uses the natural logarithm of total loans between a firm-bank as the dependent variable; columns (2) and (3) use the natural logarithm of one plus the weighted-average of nominal and real interest rates for loans, respectively, between a firm-bank as the dependent variable. The 'K Inflows' variable is real quarterly gross capital inflows into Turkey, the overnight rate is the quarterly average, and FX is a 0/1 dummy indicating whether a loan is in foreign currency (= 1) or domestic (= 0). Lagged Turkish real GDP growth, inflation, Turkish lira/US dollar exchange rate change, and a linear time trend are included as regressors. Furthermore, the following 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.

Panel B presents the first-stage regression for the IV, which is run at the bank×quarter level for the whole sample period. The first-stage 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. These regressions include both VIX and the US 10 year/3month spread.

'a' indicates significance at the 1% level, 'b' at the 5% level, and 'c' at the 10% level.

Table A11. Banks' Leverage and Balance Sheet Effects for Loans and Interest Rates: OLS Estimates, 2003–13

	$\log(\text{Loans}_q)$			$\log(1+r_q)$		
	(1)	(2)	(3)	(4)	(5)	(6)
$\log(\text{VIX}_{q-1})\times\text{Capital}_b$	-0.028			-0.001		
	(0.027)			(0.002)		
$\Delta\log(\text{XR}_{q-1})\times\text{Capital}_b$		-0.092			0.002	
		(0.101)			(0.010)	
$\mathbb{1}(\text{Depreciation}_{q-1})\times\text{Capital}_b$			-0.006			-0.001
			(0.015)			(0.001)
FX	0.690^a	0.690^a	0.690^a	-0.070^a	-0.070^a	-0.070^a
	(0.013)	(0.013)	(0.013)	(0.003)	(0.003)	(0.003)
Observations	9,280,825	9,280,825	9,280,825	9,280,825	9,280,825	9,280,825
R-squared	0.876	0.876	0.876	0.857	0.857	0.857
Bank×firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Bank controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm×quarter F.E.	Yes	Yes	Yes	Yes	Yes	Yes

Notes: This table presents results for the regressions examining the balance sheet effects on banks' lending using quarterly data for all loans. Regressions interact changes in VIX and exchange rates with banks' capital (the inverse of leverage).Columns (1)-(3) use the natural logarithm of total loans between a firm-bank as the dependent variable, and columns (4)-(6) use the natural logarithm of the weighted average of the and real interest rates for loans between a firm-bank as the dependent variable. These regressions follow the same specifications as the double interaction regressions in Table 4. Columns (1) and (4) present the double interaction from regression of banks' capital and VIX; column (2) and (5) interact capital with lagged exchange rate changes viz. the US, where an increase is a depreciation, and columns (3) and (6) interact capital with a dummy variable indicating whether the exchange rate depreciated or not. FX is a 0/1 dummy indicating whether a loan is in foreign currency (= 1) or domestic (= 0). The lagged values of the following bank-level characteristics are also controlled for in all specifications (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. 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.

Table A12. Exchange Rate Changes, Loans and Real Interest Rates at Loan Origination: OLS Estimates, 2003–13

	$\log(\text{Loans}_m)$			$\log(1+r_m)$		
	(1)	(2)	(3)	(4)	(5)	(6)
Collateral/Loan	0.103[a]	0.090[a]	0.093[a]	-0.002[b]	-0.004[a]	-0.003[a]
	(0.005)	(0.010)	(0.012)	(0.001)	(0.001)	(0.001)
Collateral/Loan×Δ logXR	-0.045	0.005	-0.005	-0.009	-0.003	-0.007
	(0.095)	(0.098)	(0.133)	(0.006)	(0.010)	(0.013)
FX	0.409[a]	0.455[a]	0.511[a]	-0.081[a]	-0.077[a]	-0.077[a]
	(0.020)	(0.037)	(0.043)	(0.003)	(0.003)	(0.005)
Observations	18,239,721	13,043,273	11,311,762	18,239,721	13,043,273	11,311,762
R-squared	0.731	0.833	0.845	0.646	0.832	0.855
Bank×firm F.E.	Yes	Yes	No	Yes	Yes	No
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Risk F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Maturity F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	No	No	Yes	No	No
Firm×month F.E.	No	Yes	No	No	Yes	No
Bank×firm×month F.E.	No	No	Yes	No	No	Yes

Notes: This table presents results for regressions using monthly data at the loan level. All variables are measured at the loan level, where 'Collateral/Loan' ratio is the collateral-to-loan ratio, and 'FX' is a dummy variable indicating whether the loan is in foreign currency (= 1) or Turkish lira (= 0). The regressions further include (i) bank defined risk weights, (ii) sectoral activity, and (iii) maturity levels. Columns (1)-(3) presents results for the natural logarithm of loan value, and columns (4)-(6) for the real interest rate. Columns (1) and (4) control for monthly fixed effects; columns (2) and (5) control for firm×month fixed effects; and columns (3) and (6) control for firm×bank×month fixed effects. 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.