Capital Flows, International Spillovers and Domestic Credit Cycles

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IADB-BIS Conference on Cross-border Flows in a New Economic Environment: Challenges and Policy Options for Latin America

Broad Research Agenda: Patterns of Capital Flows and Implications for International Transmission

I will summarize key results from two papers:

1. **Gross Capital Flows by Banks, Corporates, and Sovereigns** (with Avdjiev, Hardy, Serven)

2. **International Spillovers and Local Credit Cycles** (with Baskaya, di Giovanni, Ulu)

Importance of Capital Flows

1. Transmission of real and financial shocks across borders
2. The distribution of global risk
3. Countries' own macroeconomic outcomes

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3. Countries' own macroeconomic outcomes

- Extensive research on **net** capital flows, much less on **gross** flows
- Important to understand patterns of gross capital flows by **borrower and lender sectors**
  - Gross flows, but no sectoral breakdown
    - Forbes and Warnock(2012), Broner et al. (2013), Milesi-Ferretti and Tille(2011),and Bluedorn et al. (2013)
  - Public-Private sector breakdown, but of net flows
    - Aguiar and Amador(2011), Gourinchas and Jeanne(2013), and Alfaro, Kalemli-Ozcan, Volosovych (2014)

New Data

- We construct a dataset on gross capital **inflows**:
  - quarterly from1996q1 to 2014q4
  - balanced panel of 85 countries: 25 AE, 34 EM, 26 DE
- We construct a dataset on gross capital **outflows**:
  - quarterly from 2004q1 to 2014q4
  - balanced panel of 31 countries: 15 AE, 16 EM
- Break down debt inflows and outflows by:
  - sovereigns (government, central bank)
  - banks
  - corporates

Why decompose debt into borrowing sectors?

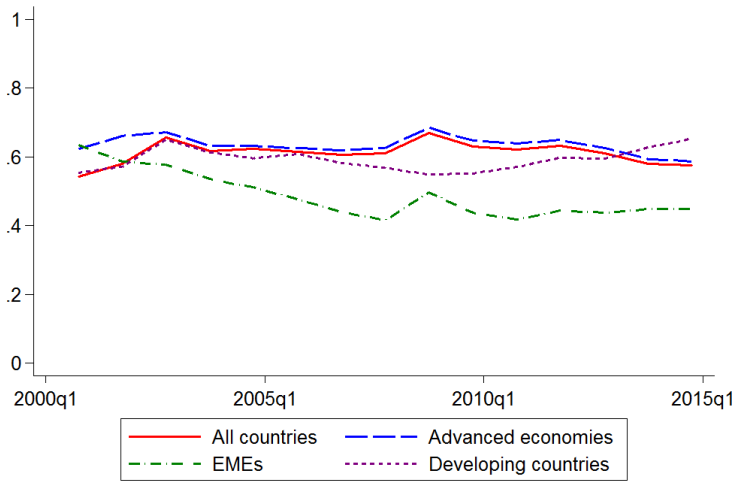

Figure: Share of Debt in External Borrowing

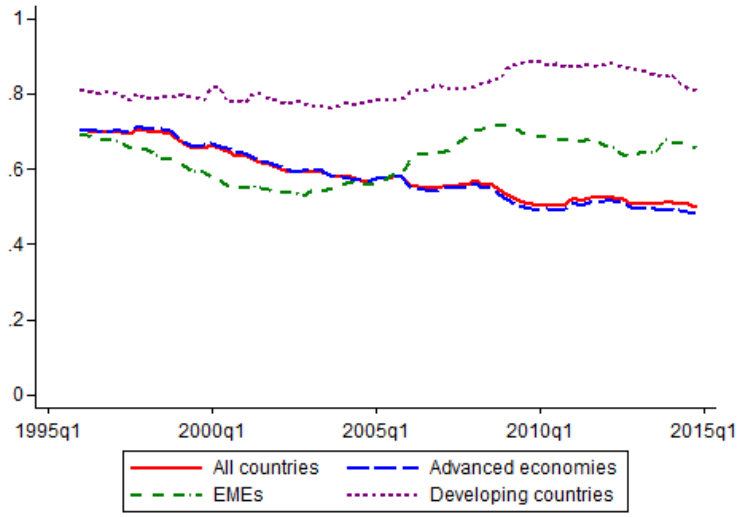

Figure: Share of OID in External Debt

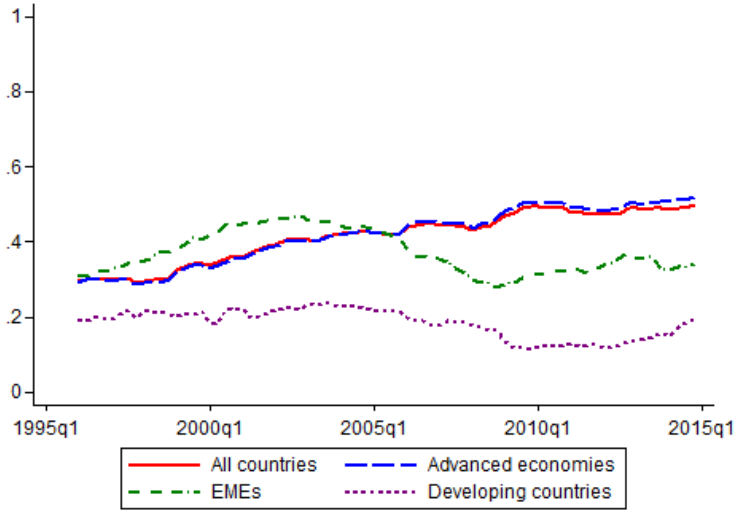

Figure: Share of PD in External Debt

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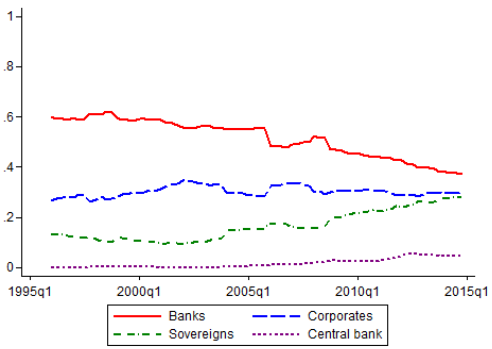
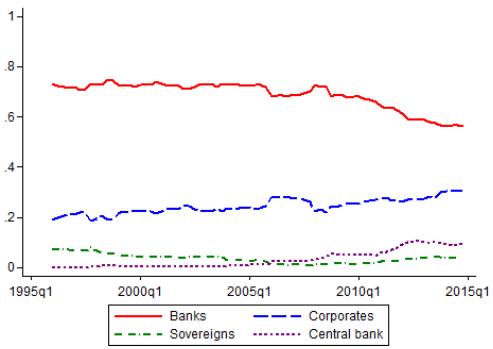


Figure: Debt, AE



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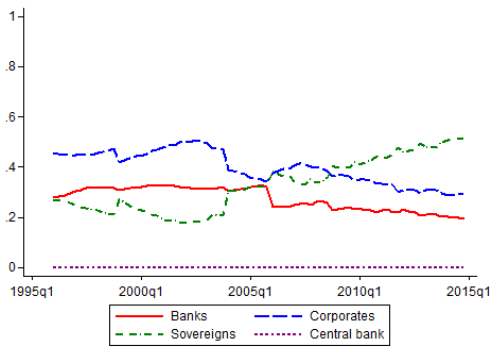


Figure: PD, AE

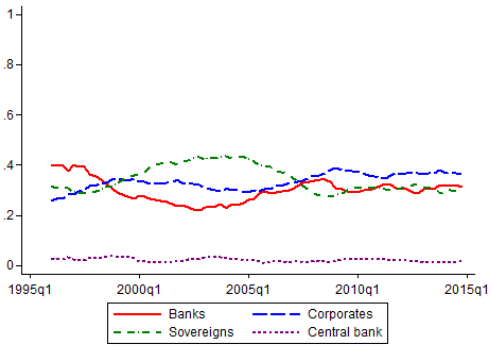
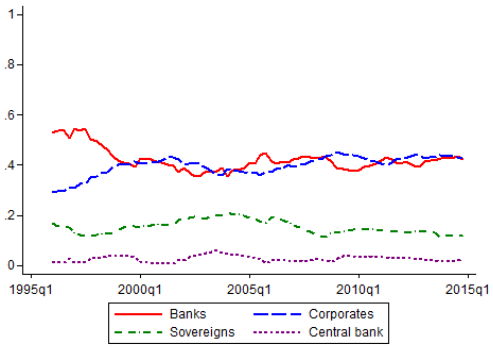


Figure: Debt, EM



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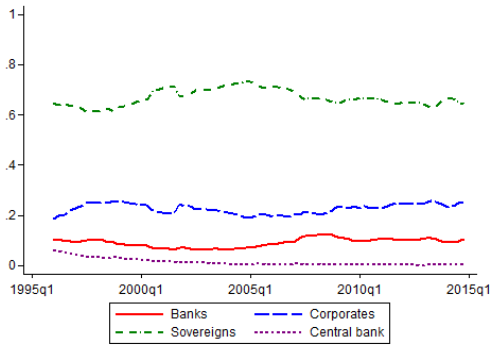


Figure: PD, EM

Role of Global Uncertainty and Country Fundamentals

Question: Are capital inflows and outflows driven by global conditions in addition to country fundamentals?

$$\frac{FLOW_{it}}{GDP_{it}} = \alpha_i + \beta \log(VIX_{t-1}) + \gamma GDPGrowth_{it-1} + \epsilon_{it}$$

Panel Regressions: Capital Inflows

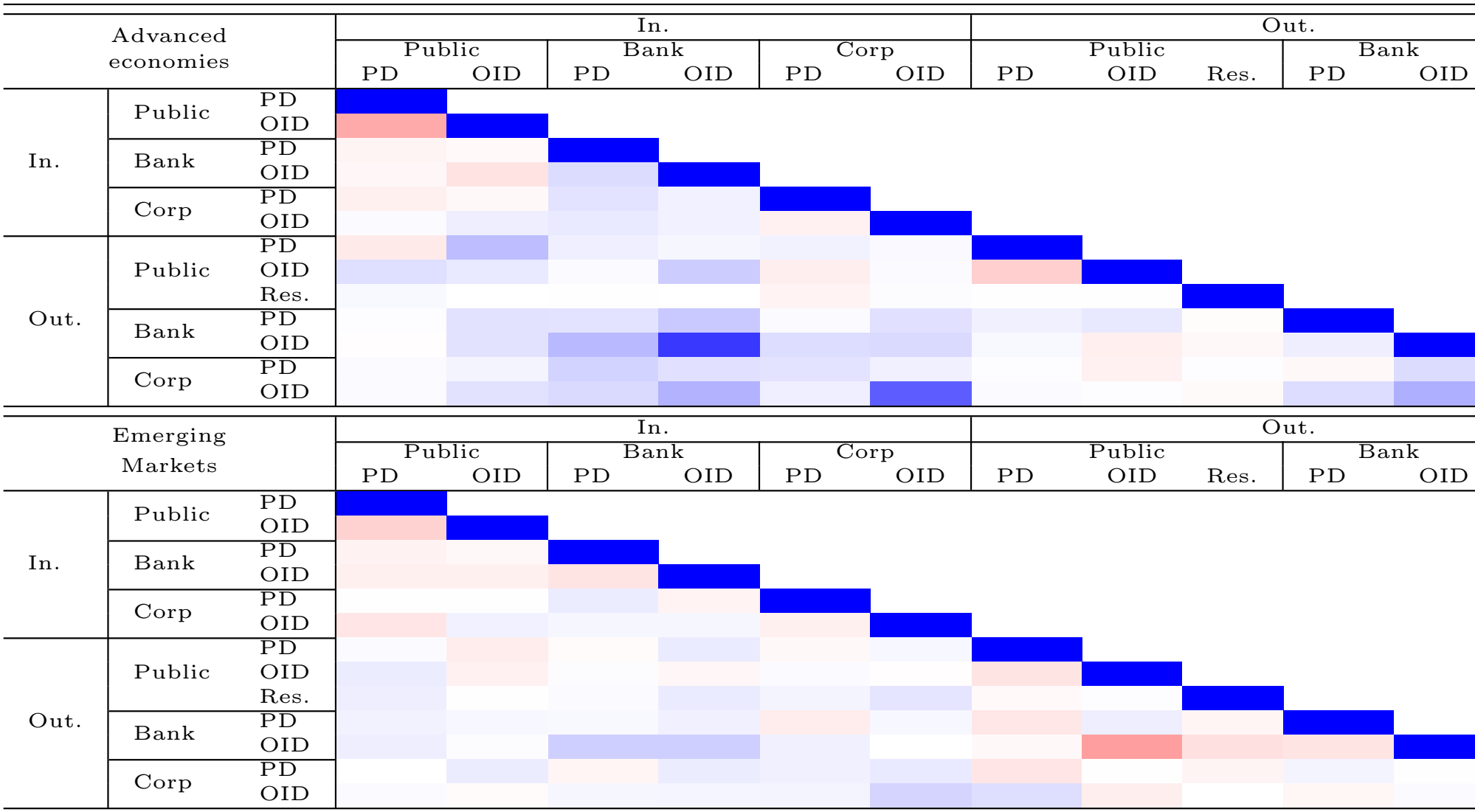
Advanced Economies

	Total	Public	Banks	Corp.
$\log(\text{VIX}_{t-1})$	-9.101***	0.813	-7.630***	-2.284**
	(2.676)	(1.400)	(2.068)	(0.962)
GDP Growth_{it-1}	0.506***	0.0616	0.363**	0.0819
	(0.179)	(0.0340)	(0.131)	(0.0466)
Observations	1127	1127	1127	1127
R^2	0.065	0.002	0.056	0.026
CountryFE	Yes	Yes	Yes	Yes

Emerging Markets

	Total	Public	Banks	Corp.
$\log(\text{VIX}_{t-1})$	-2.261**	1.077	-2.265***	-1.073***
	(0.829)	(0.652)	(0.706)	(0.253)
GDP Growth_{it-1}	0.116***	-0.0394***	0.118***	0.0381***
	(0.0347)	(0.0123)	(0.0346)	(0.00928)
Observations	1372	1372	1372	1372
R^2	0.071	0.021	0.116	0.075
CountryFE	Yes	Yes	Yes	Yes

Capital Inflow-Outflow Correlations by Sector



Conditional Correlations. Blue (+), red (−) correlation.

Key Takeaways

- Inflows and outflows co-move due to banks borrowing and lending
- Public and private gross flows move in opposite direction; stronger for EM.
- Banks and corporates can be both sources of procylicality when global shocks occur:
  - High VIX $\rightarrow$ K inflows to banks, and corporates $\downarrow$
  - High VIX $\rightarrow$ K outflows by banks, and corporates $\downarrow$
- EM sovereigns are very different than AE sovereigns:
  - $\Rightarrow$ cyclical properties of borrowing/lending and response to global shocks

What is the Role of Capital Flows for Spillovers?

Large debate on how advanced country shocks and policies affect emerging market business cycles.

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Christine Lagarde, November 2, 2017:

1. How do policy decisions in AE drive conditions in ROW? (spillovers)
2. What channels transmit these spillovers?
3. How do we use this information to built a better financial system and mitigate risks?

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Our research exploits a new and a very large dataset from a particular EM to address these questions

Stylized Facts

In Emerging Markets:

- Business cycles correlate strongly with credit cycles.
- Capital flows go hand-in-hand with credit cycles.

$\Rightarrow$ Often resulting in financial crisis.

- EM policy makers: "capital inflows/outflows problem."

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- EM policy makers: "capital inflows/outflows problem."

We ask:

- Do capital flows *causally* drive domestic credit cycles in EMs?
- If so, what are the mechanisms at work?

Challenges: Identification

- Relative importance of "pull" or "push" factors for capital flows?
  - ⇒ Is domestic credit growth being driven by exogenous international supply of credit?
  - ⇒ Standard open economy models: capital flows are an endogenous response to a domestic or external shock to C and/or I.
  - ⇒ No role for global shocks/foreign investor sentiment under UIP.

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  - ⇒ No evidence on the *quantitative* role of heterogeneity for aggregate outcomes.
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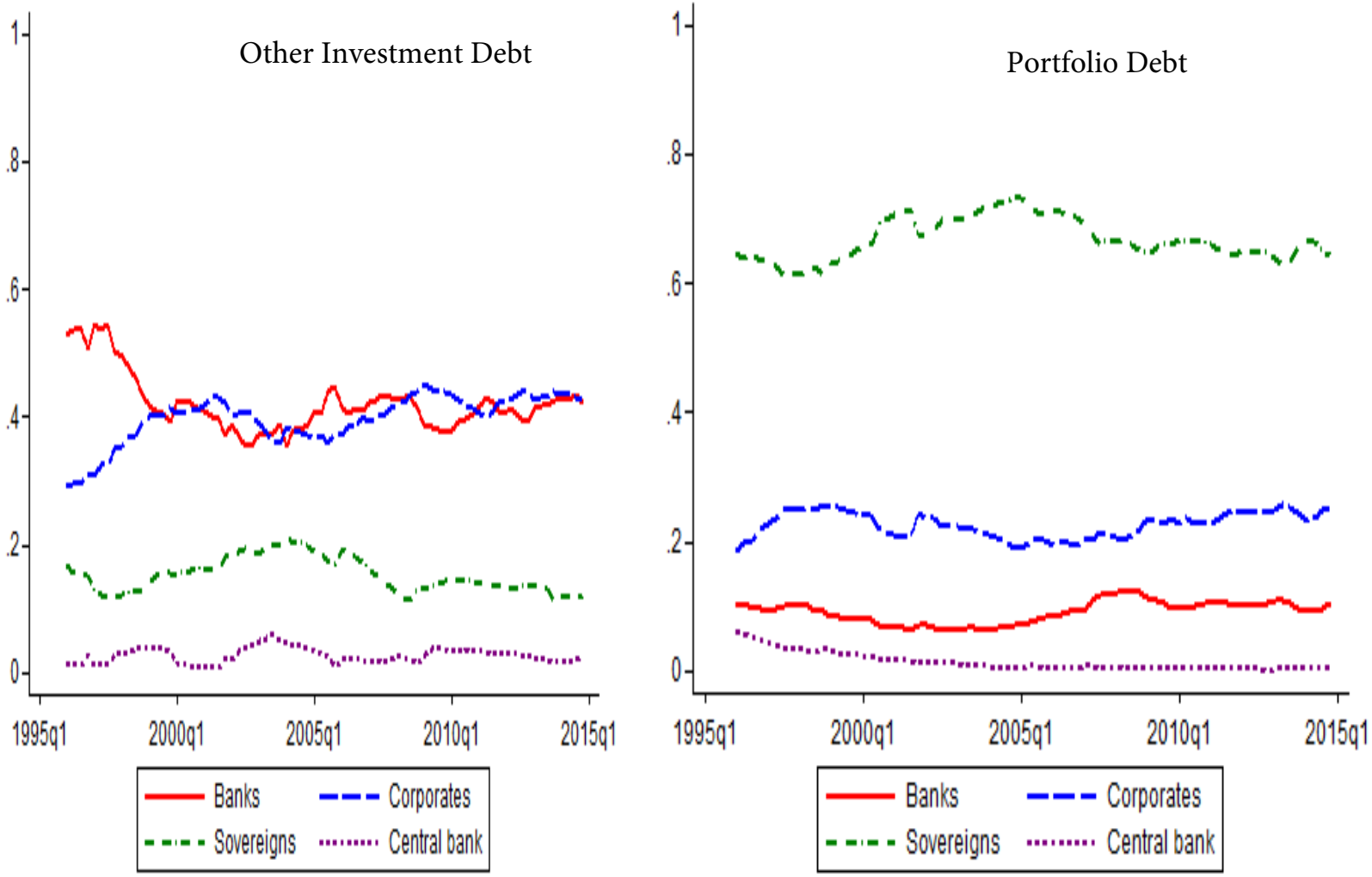
  - ⇒ Needed to design a better macroprudential policy
- A Big Data Approach: Exploit micro data from credit register of Turkey together with bank-level, firm-level, macro data over 2003–13.
  - ⇒ A panel on every single loan contract between a bank and a firm in a representative EM.
  - ⇒ Instrument capital flows with VIX to investigate effect of capital flows driven by "risk-on" episodes.
  - ⇒ Evaluate the effect of push-capital flows on lending and borrowing patterns at the firm-bank level focusing on **heterogeneity in currency of borrowing and risk taking**

Recall: Emerging Market External Financing

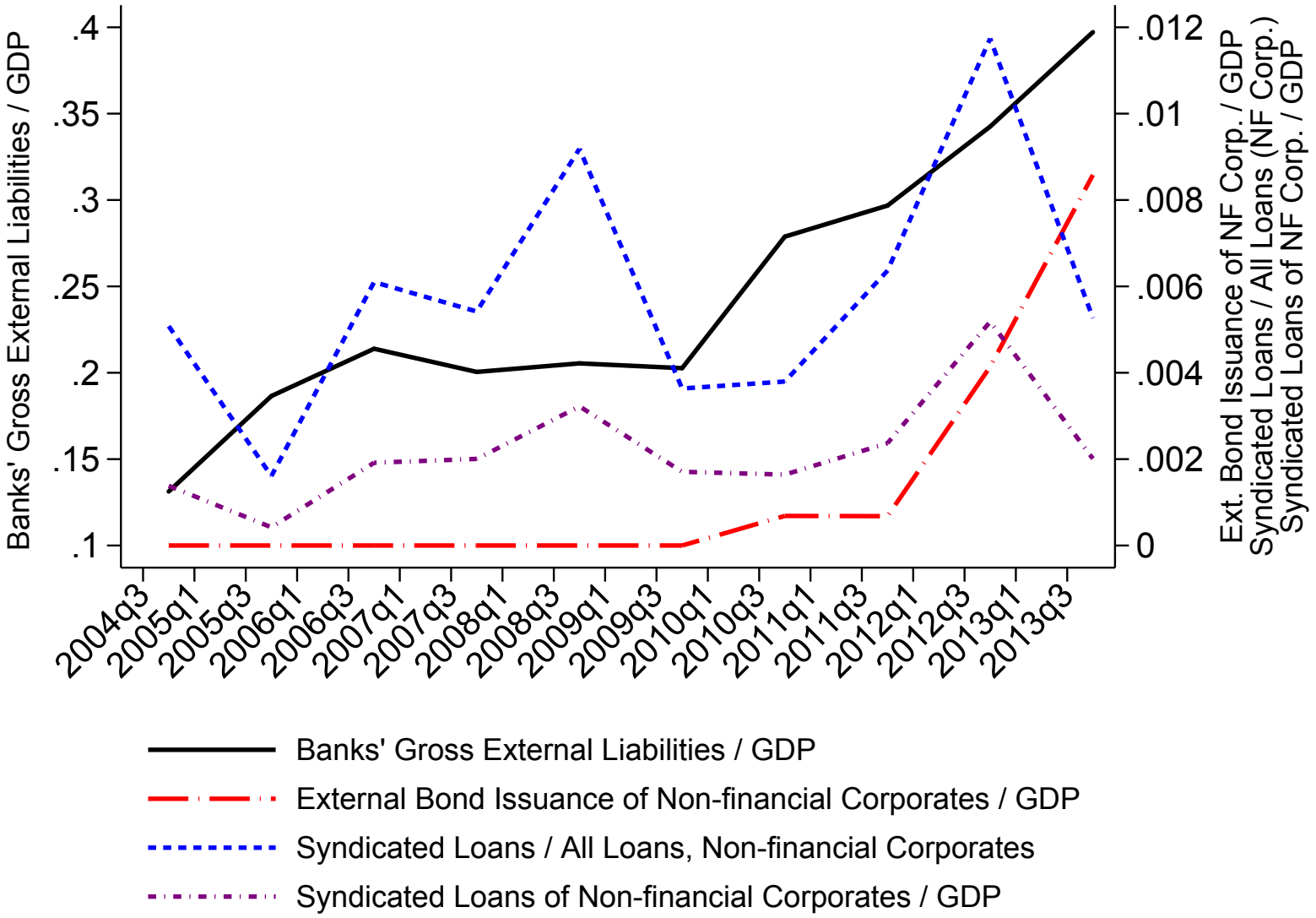
60 percent of external liabilities is debt

Within external debt: Other Investment Debt (Loans) 70%, Portfolio Debt (Bonds) 30%



Source: Avdjiev, Hardy, Kalemli-Ozcan, Serven (2017).

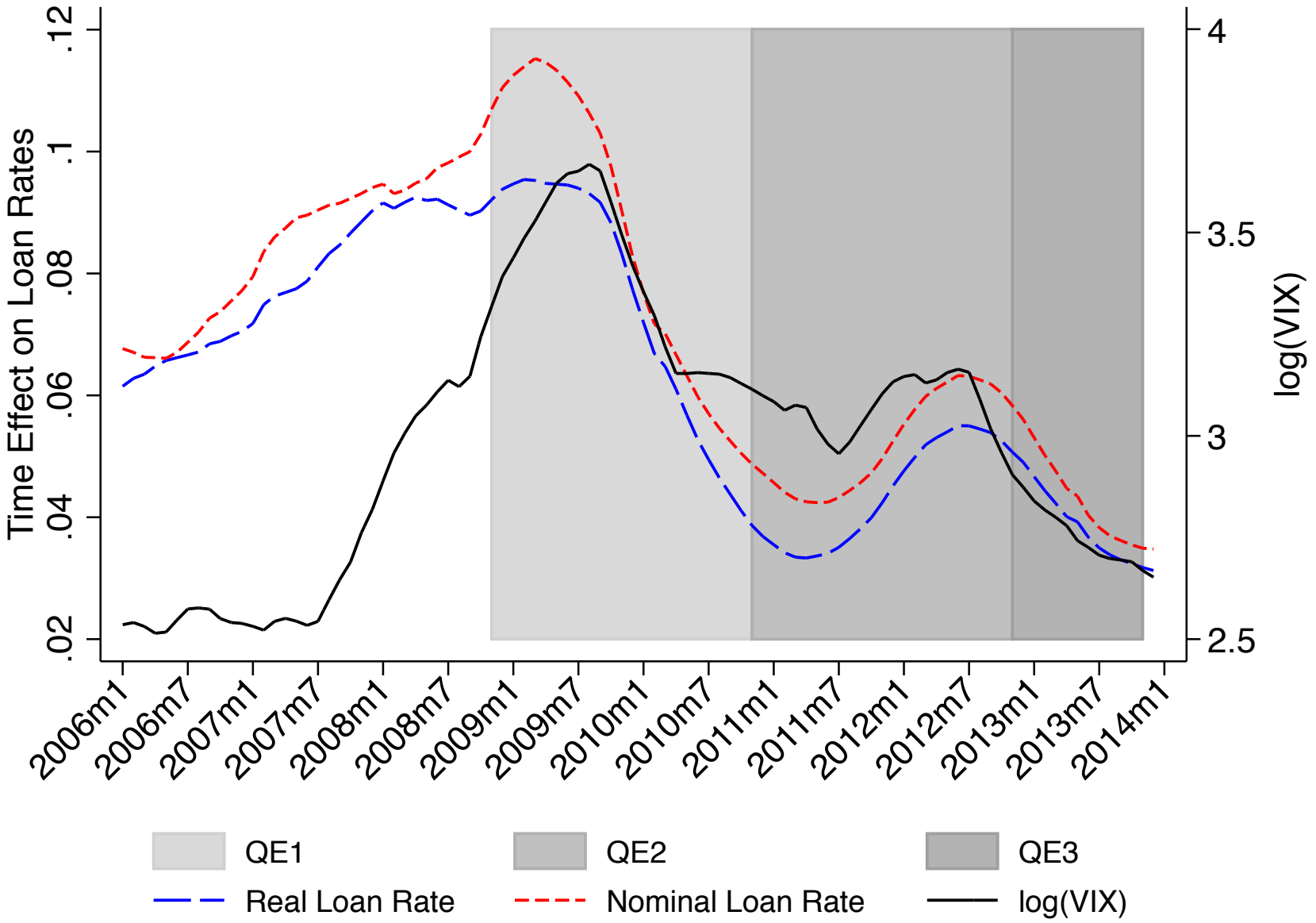
Bank and Firm External Financing in Turkey



Sources: CBRT; Hale, Kapan, Minoiu (2017).

QE, VIX, Interest Rates

Effect of VIX on Dynamics of Real Borrowing Costs



Key Takeaways

1. Supply ("push") driven capital inflows have a *quantitatively* important impact on domestic credit cycle
   - Large effect of VIX on capital flows (elasticity -1.7 & partial $R^2 = 0.40$).
   - An increase in capital flows equivalent to its IQR leads to 1 pp reduction in real borrowing costs.
   - Supply driven capital inflows explain 43% of *aggregate* corporate sector cyclical credit growth on average.

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$\Rightarrow$ **Two margins of adjustment**: interest rate and collateral.
   - Different from relaxation of borrowing constraints with capital flows.

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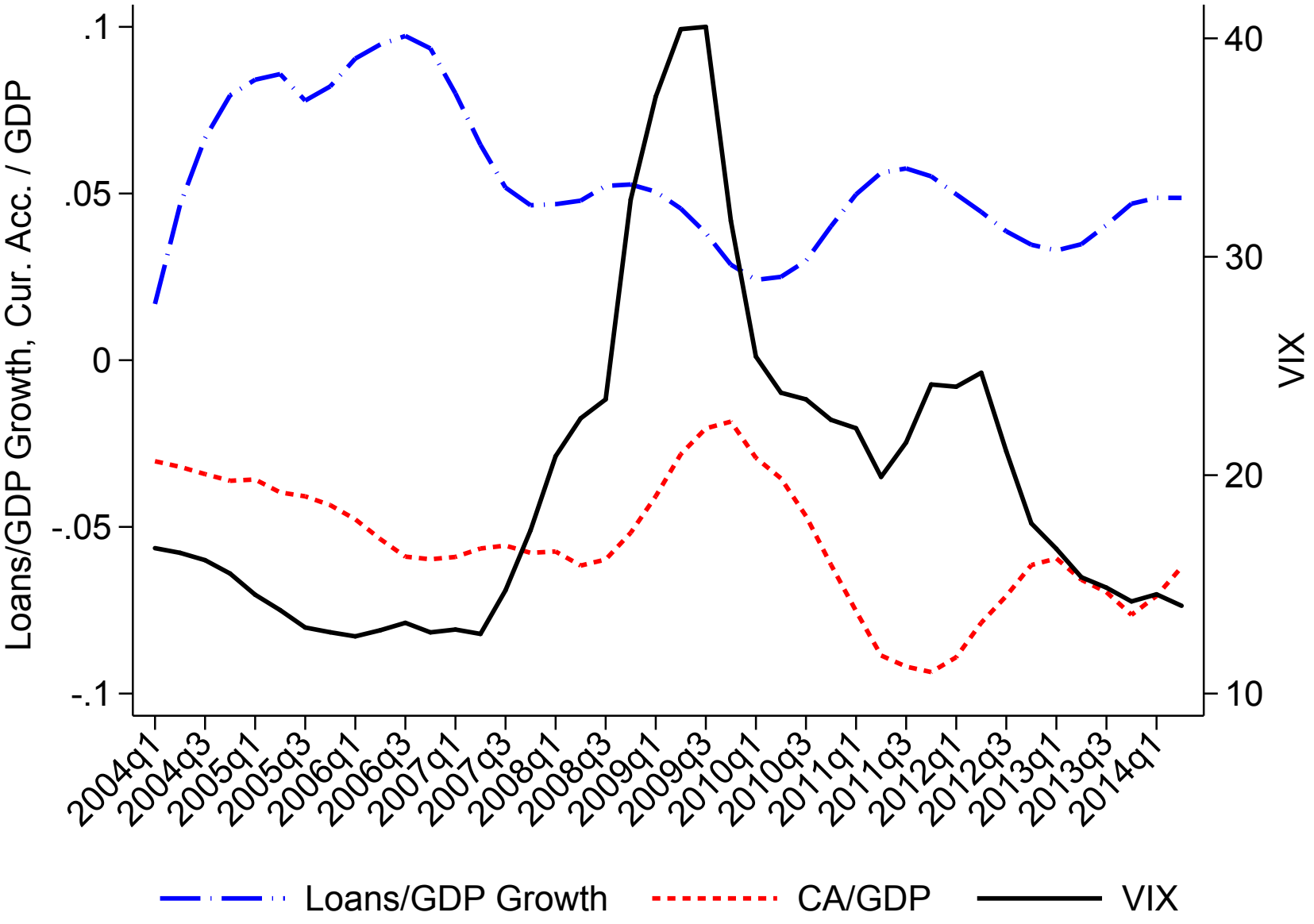
Support for the existence of a financial trilemma:

Regardless of the exchange rate regime, achieving financial stability is difficult under:

1. National financial regulation,
2. Free capital flows, and
3. A global financial cycle.

⇒ Obstfeld (2015); Obstfeld, Ostry, Qureshi (2017)

VIX, CA/GDP, and Domestic Credit in Turkey



Panel Regressions: Outflows

Panel B: Advanced Economies

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Public	Banks	Corp.	Total + Reserves	Public + Reserves
$\log(\text{VIX}_{t-1})$	-11.61***	0.0888	-9.121**	-2.575**	-10.66**	1.040
	(3.772)	(2.400)	(3.233)	(0.966)	(3.965)	(2.606)
GDP Growth_{it-1}	0.339**	0.0553	0.263**	0.0204	0.337**	0.0533
	(0.116)	(0.0361)	(0.0969)	(0.0230)	(0.118)	(0.0401)
Observations	660	660	660	660	660	660
R^2	0.082	0.004	0.087	0.025	0.074	0.004
CountryFE	Yes	Yes	Yes	Yes	Yes	Yes

Panel C: EM

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	Public	Banks	Corp.	Total + Reserves	Public + Reserves
$\log(\text{VIX}_{t-1})$	-2.223***	-0.813	-1.048***	-0.362**	-2.906***	-1.496
	(0.588)	(0.495)	(0.309)	(0.152)	(0.831)	(0.958)
GDP Growth_{it-1}	0.0387	-0.00157	0.0269	0.0135	0.0746***	0.0343**
	(0.0195)	(0.00914)	(0.0154)	(0.00989)	(0.0234)	(0.0159)
Observations	704	704	704	704	704	704
R^2	0.045	0.009	0.017	0.011	0.067	0.020
CountryFE	Yes	Yes	Yes	Yes	Yes	Yes

Macro Regressions: OLS and IV

★ Low VIX/high capital inflow episodes lead to more credit and lower rates
★ IV estimates systematically larger (in absolute value) than OLS

Panel A. OLS and Second-stage of IV

	log(Loans$_q$)		log(1+i_q)		log(1+r_q)	
	OLS (1)	IV (2)	OLS (3)	IV (4)	OLS (5)	IV (6)
log(K Inflows$_{q-1}$)	0.040^a	0.041^b	-0.005^a	-0.011^a	-0.005^b	-0.010^a
	(0.006)	(0.017)	(0.001)	(0.002)	(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	0.171	0.231^a	0.192^a	0.046	0.009
	(0.262)	(0.325)	(0.022)	(0.023)	(0.059)	(0.053)
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(K inflows$_q$) Regression

log(VIX$_{q-1}$)	Observations	R-squared	F-stat
-1.667^a	1,685	0.5625	15.28
(0.427)			

Contribution

Macro Literature so far:

- Many papers on the transmission of VIX/US Policy on global/country specific **asset prices.** (e.g., Bruno and Shin; Rey)
- Little consensus on whether VIX/US policy drive/explain **capital flows** to EMs (e.g., Cerutti-Claessens-Rose; Rey, Forbes-Warnock).
- Missing: causal evidence on the effect of exogenous "risk-on-flows" on EMs' *real and financial outcomes.*

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	Macro Data	**Micro Data**
Pros	Comparability country/time	Identification | F, P, UF Pin down the mechanism
Cons	Identification is hard (unobserved factors, UF) Different fundementals/policies (F, P) Hard to pin down the mechanism Different frequency of P&Q data	Specific country/episode

Conceptual Framework

Borrowing/funding costs decline with exogenous capital flows.
UIP with time varying risk premium:

$$i_{c,t} = i_t^* + \mathbb{E}_t \Delta e_{t+1} + \gamma_{c,t}, \quad \text{where}$$
$$\gamma_{c,t} \equiv \omega \text{VIX}_t + \alpha_{c,t}$$

At *firm-bank* level:

$$\gamma_{f,b,t} \equiv \alpha_{f,t}, \quad \text{then}$$
$$i_{f,b,t} = i_t + \gamma_{f,b,t}$$
$$= i_t^* + \mathbb{E}_t(\Delta e_{t+1}) + \omega \text{VIX}_t + \alpha_{c,t} + \alpha_{f,t}$$

Assuming PPP:

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

Data: UIP fails and VIX strongly correlates with regression residuals.

▸ UIP regressions

Empirical Strategy: Two-Layer Identification

Layer I: Macro Credit Supply Shock

- Analyze impact of VIX on firm-bank-loan level borrowing/lending, both in IV and reduced-form regressions.
- Focus on domestic credit variables, both volume (loans) and price (interest rate) for identification.
- Include time-varying firm and bank variables, bank×firm fixed effects, firm-year effects and macro fundementals/expectations/policy rate.

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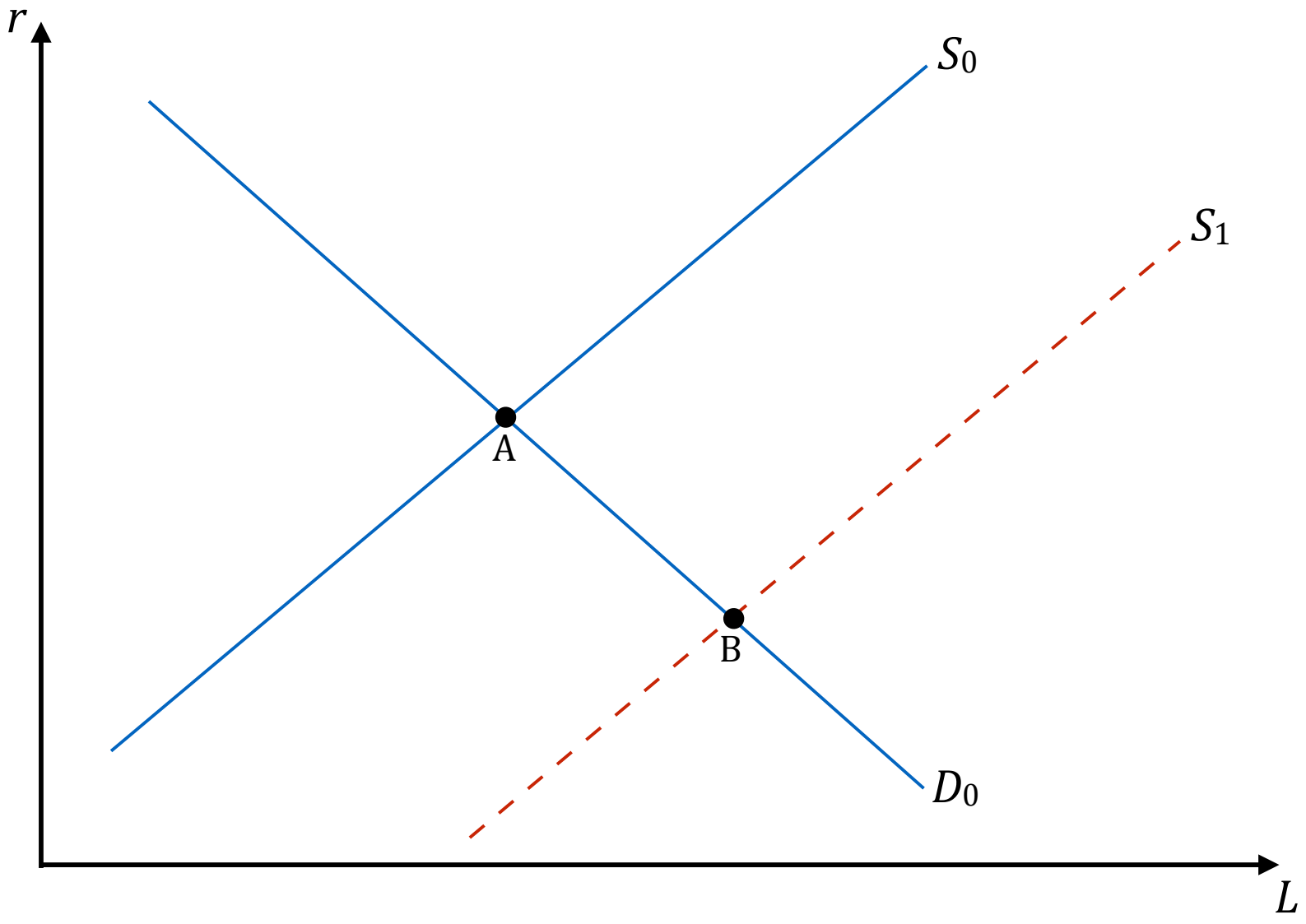
Layer II: Within-Firm and Within-Firm-Bank Estimators

1. We use a within firm estimator via firm×quarter fixed effects:
   - Analyze firms that borrow from multiple banks (Khwaja-Mian, Jimenez et al., Chodorow-Reich).
   - Exploit heterogeneity in non-core ratio at bank level.
2. Drill down to *loan level* to investigate firm credit constraints (lower cost versus hard collateral):
   - Identification from within firm-bank pair (firm×bank×month fixed effects)
   - Exploit heterogeneity in collateral ratio of newly issued loans.

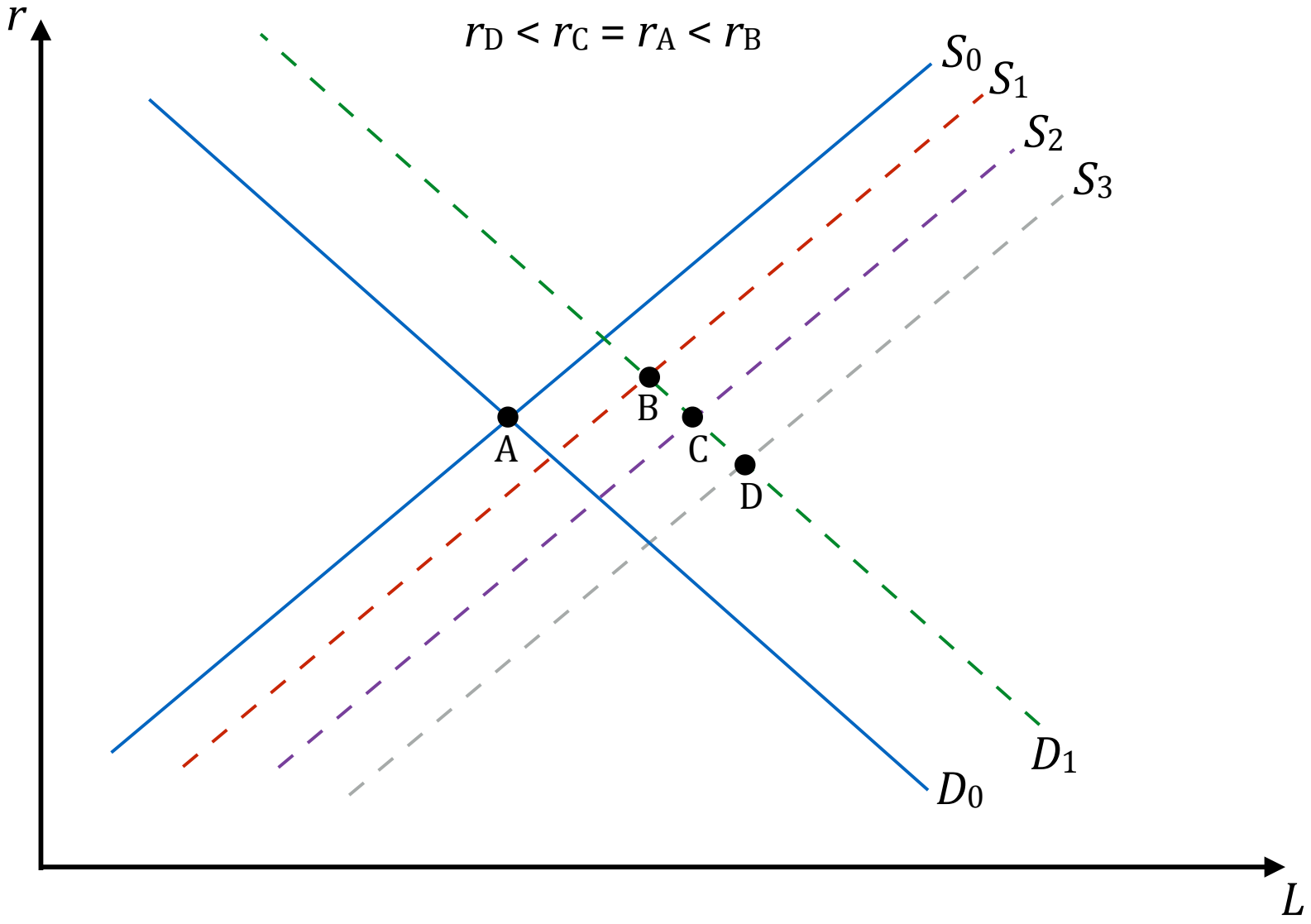
Basics of "Macro" Identification

Supply Shock



Basics of "Macro" Identification

Demand and Supply Shocks



"Macro" Capital Flows Regressions

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

- Y: Loan or interest rate (nominal and real) at firm (f)×bank (b)×currency denomination (d)×quarter (q) level
- Capital inflows: Turkish real inflows

  ⇒ Instrument with VIX.
- FX: FX dummy (0 = TL, 1 = FX).
- **Bank**: log(Assets), capital ratio, liquidity ratio, noncore ratio, ROA.
- **Macro controls**: GDP growth, inflation, exchange rate change, expectations, policy rate.
- Include **firm×year** effects to control slow-moving demand.

Macro Regressions: OLS and IV

★ Low VIX/high capital inflow episodes lead to more credit and lower rates
★ IV estimates systematically larger (in absolute value) than OLS

Panel A. OLS and Second-stage of IV

	log(Loans$_q$)		log(1+i_q)		log(1+r_q)	
	OLS (1)	IV (2)	OLS (3)	IV (4)	OLS (5)	IV (6)
log(K Inflows$_{q-1}$)	0.040^a	0.041^b	-0.005^a	-0.011^a	-0.005^b	-0.010^a
	(0.006)	(0.017)	(0.001)	(0.002)	(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	0.171	0.231^a	0.192^a	0.046	0.009
	(0.262)	(0.325)	(0.022)	(0.023)	(0.059)	(0.053)
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(K inflows$_q$) Regression

log(VIX$_{q-1}$)	Observations	R-squared	F-stat
-1.667^a	1,685	0.5625	15.28
(0.427)			

First stage with US MP; Other Works—Brauning and Ivashina (2017); Morais et al. (2015)

VIX Reduced-Form Regressions

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

	$\log(\mathrm{Loans}_q)$	$\log(1+i_q)$	$\log(1+r_q)$
	(1)	(2)	(3)
$\log(\mathrm{VIX}_{q-1})$	-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

Bank-type regressions Robustness

Heterogeneity: Differences-in-Differences

Bank and Firm Risk-Taking:

$$\log \mathrm{Y}_{f,b,d,q} = \alpha_{b,q} + \alpha_{f,q} + \kappa(\mathrm{Noncore}_b \times \mathrm{NetWorth}_f \times \log \mathrm{VIX}_{q-1}) + \delta_2 \mathrm{FX}_{f,b,d,q} + \vartheta_{f,b,d,q}$$

- Lower rates and more credit from banks with higher non-core liabilities.
- Low net worth firms obtain *lower rates* from high non-core banks, but they *do not borrow more* than high net worth firms given collateral constraints (loan-level evidence).

Estimation details | Regressions | Loan-level results | Risk-taking channels

Aggregate Impact: "Macro" Regression

$$\log \mathrm{Y}_{f,b,d,q} = \widetilde{\alpha}_{f,b} + \widetilde{\lambda}\mathrm{Trend}_q + \widetilde{\beta}\log \mathrm{VIX}_{q-1} + \xi_{f,b,d,q}$$

$$\Rightarrow \log(\widehat{\mathrm{Loan}}_{f,b,d,q}) = \widehat{\widetilde{\beta}}\log(\mathrm{VIX}_{q-1})$$

Differentiate and multiply by $w_{f,b,d,q-1}$, such that $\sum w_{f,b,d,q-1} = 1$:

$$w_{f,b,d,q-1}\mathrm{dlog}(\widehat{\mathrm{Loan}}_{f,b,d,q}) = w_{f,b,d,q-1}\widehat{\widetilde{\beta}}\mathrm{d}\log(\mathrm{VIX}_{q-1})$$

so,

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

Summing above equation over $\{f, b, d\}$ in a given quarter q:

$$\left(\frac{\widehat{\Delta\mathrm{Agg.\ Loan}}}{\mathrm{Agg.\ Loan}}\right)_q = \widehat{\widetilde{\beta}}\left(\frac{\Delta\mathrm{VIX}}{\mathrm{VIX}}\right)_{q-1}$$

$$\frac{\mathrm{Avg}\left\{\left(\frac{\widehat{\Delta\mathrm{Agg.\ Loan}}}{\mathrm{Agg.\ Loan}}\right)_q\right\}}{\mathrm{Avg}\left\{\left(\frac{\Delta\mathrm{Agg.\ Loan}}{\mathrm{Agg.\ Loan}}\right)_q\right\}} = 0.43$$

Aggregate Impact: "Heterogeneity" Regression

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

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

Summing above equation over $\{f, b, d\}$ in a given quarter q:

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

$$\frac{\mathrm{Avg}\left\{\sum w^{HNC}_{q-1} (\widehat{\beta}_1 + \widehat{\beta}_2) \left(\frac{\Delta \mathrm{VIX}}{\mathrm{VIX}}\right)_{q-1}\right\}}{\mathrm{Avg}\left\{\widehat{\left(\frac{\Delta \mathrm{Agg.\ Loan}}{\mathrm{Agg.\ Loan}}\right)}_q\right\}} = 0.94$$

Merging Three Large Datasets

1. Credit register data have information on **all** loans in economy to households and firms (monthly). ▸ Data details

   Focus on loans to corporate sector. ▸ Comparison to whole economy

   - Bank, firm, currency, quarter level: 53+ million cash loans.
   - Loan value, interest rate, maturity, collateral, risk measures, ...
   - Roughly 75% of observations in value are firms with loans from multiple banks (50% in number, 2.5 bank per firm on average).

2. Bank-level data on all the balance sheet items and portfolio items for 45 banks.

   Banks capture 90 percent of corporate liabilities and 86 percent of country's financial assets.

3. Firm-level data on balance sheet and income statement (annual level).

Literature

- Older literature on push-pull of *net* capital flows
  - Calvo et al. (1993, 1996); Fernandez-Arias (1996).
- Many papers on the transmission of VIX/US Policy on global/country specific asset prices
  - Miranda-Agrippino and Rey (2015); Bruno and Shin (2015a,b); Rey (2013, 2015).
  - These papers also show a tight link between VIX and the US monetary policy
- Unclear whether VIX/US policy drive capital flows into EMs or have any effect on domestic real and financial variables
  - Work based on annual capital flows data finds mixed results; studies using quarterly bank flow data or monthly emerging market fund data find procyclical effects but not studies based on yearly IMF-BOP data
  - Fratzscher (2011); Forbes and Warnock (2012); Fratzscher et al. (2013); Ahmed and Zlate (2014); Claessens et al. (2016); Cerutti et al. (2016); Kalemli-Ozcan et al. (2016).

Contribution

UIP Regressions

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

	(1)	(2)
$\Delta e_{TL/USD,t}$	-0.005	0.122^b
	(0.083)	(0.045)
Time trend		-0.002^a
		(0.000)
Constant	0.084^a	0.336^a
	(0.006)	(0.026)
Observations	30	30
R-squared	0.010	0.780
Correlation of residuals and VIX	0.685	0.487

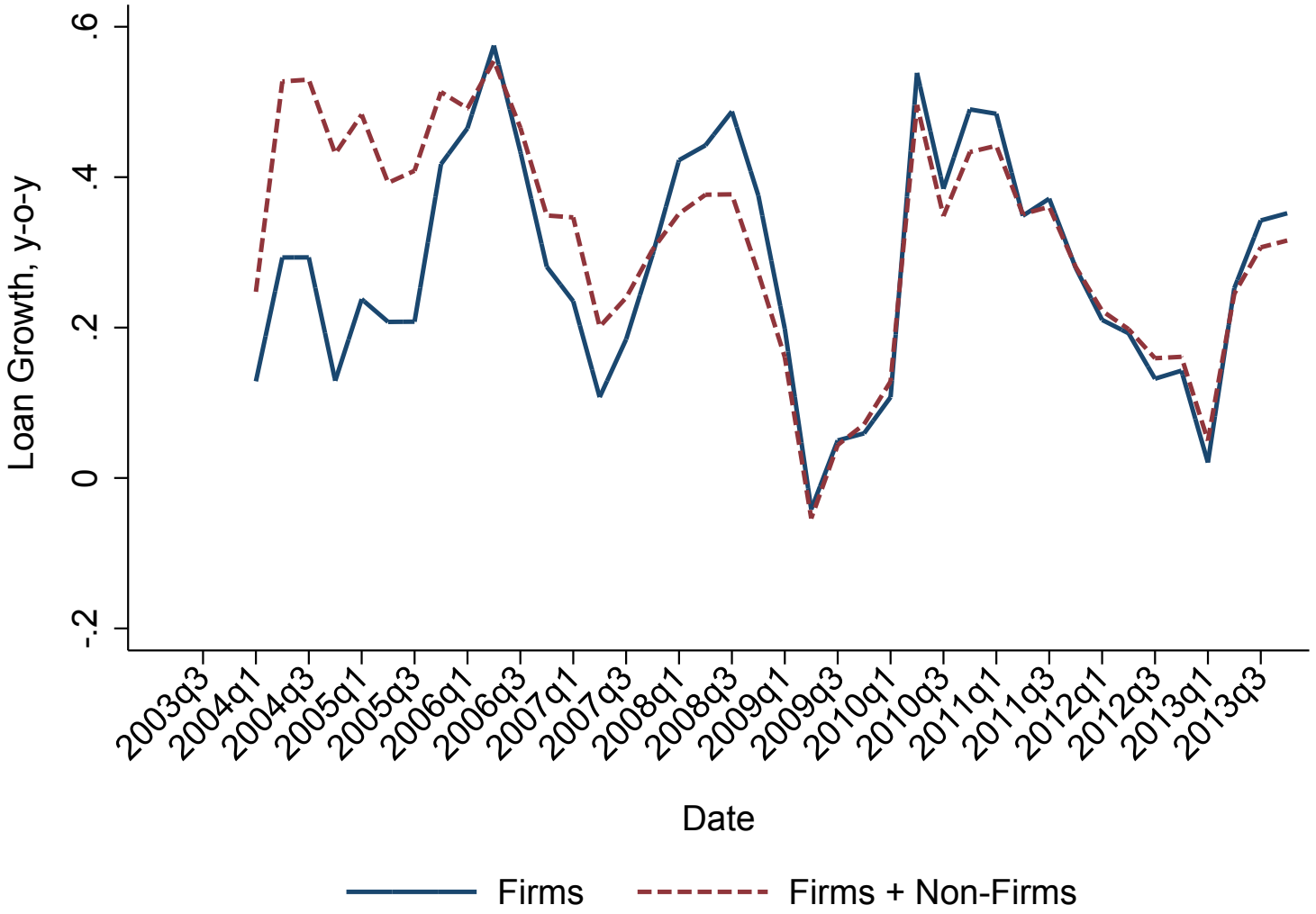
Conceptual framework

Data: Merging Three Large Datasets

1. Credit register data have information on all loans in economy to households and firms
   - Number of (cash) loans: 114 million
   - Number of loans to firms: 57 million
   - Share of firm loans: 87% in value
   - Number of bank-firm pairs: 3.3 million
2. We collapse credit register at firm-bank-quarter level going from 57 to 20.9 million observations (45 banks)
   - 50% represent firms borrowing from multiple banks
   - Multiple loans to a firm by a bank in a qiven quarter; do a weighted average
   - Currency composition: majority of loans in TL (count), but 2/3rd value in FX

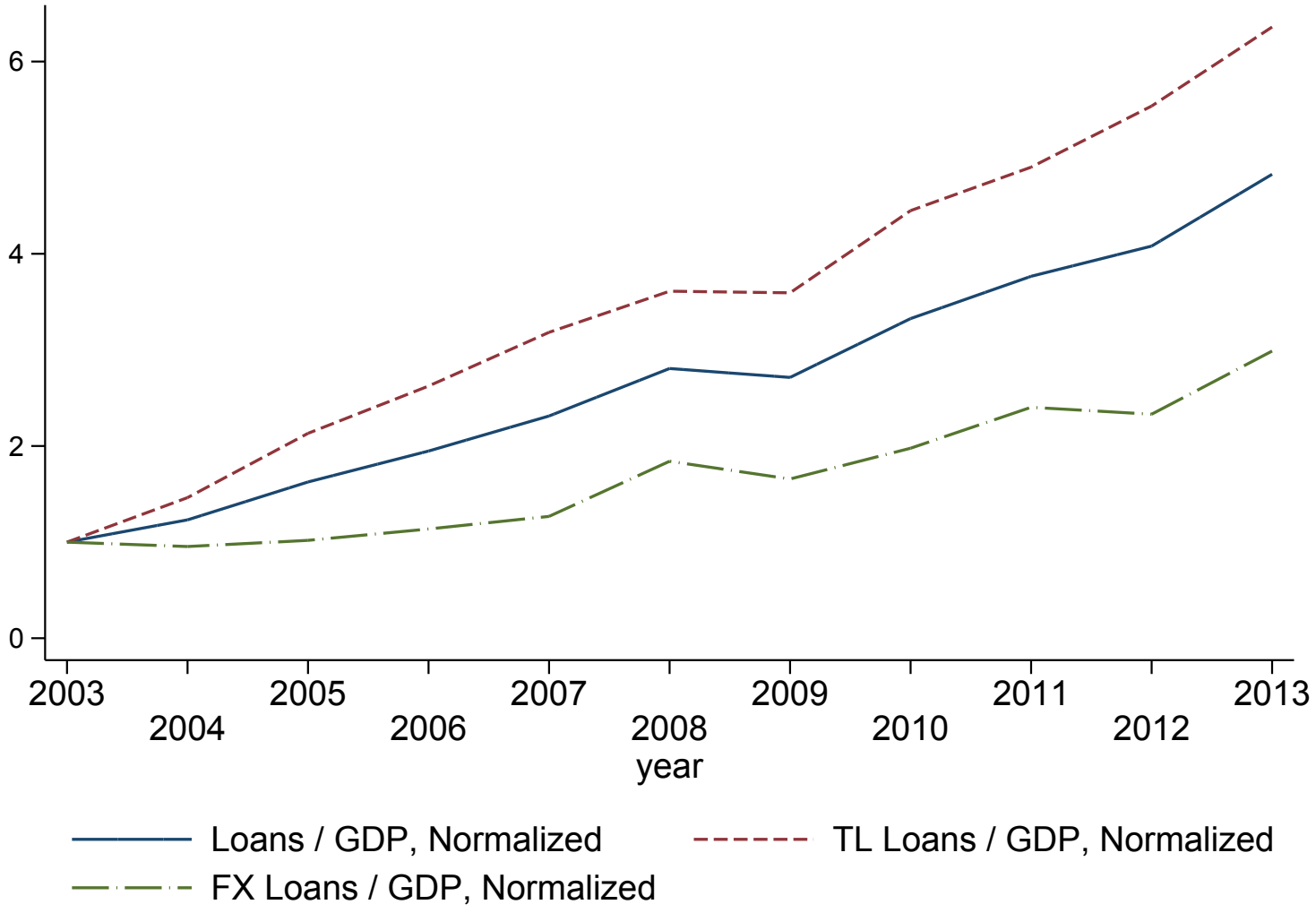
Data Summary

Loan Growth Comparison of Corporate Sector and the Whole Economy



Notes: Firm sample and whole credit registry loan growth. Data Summary

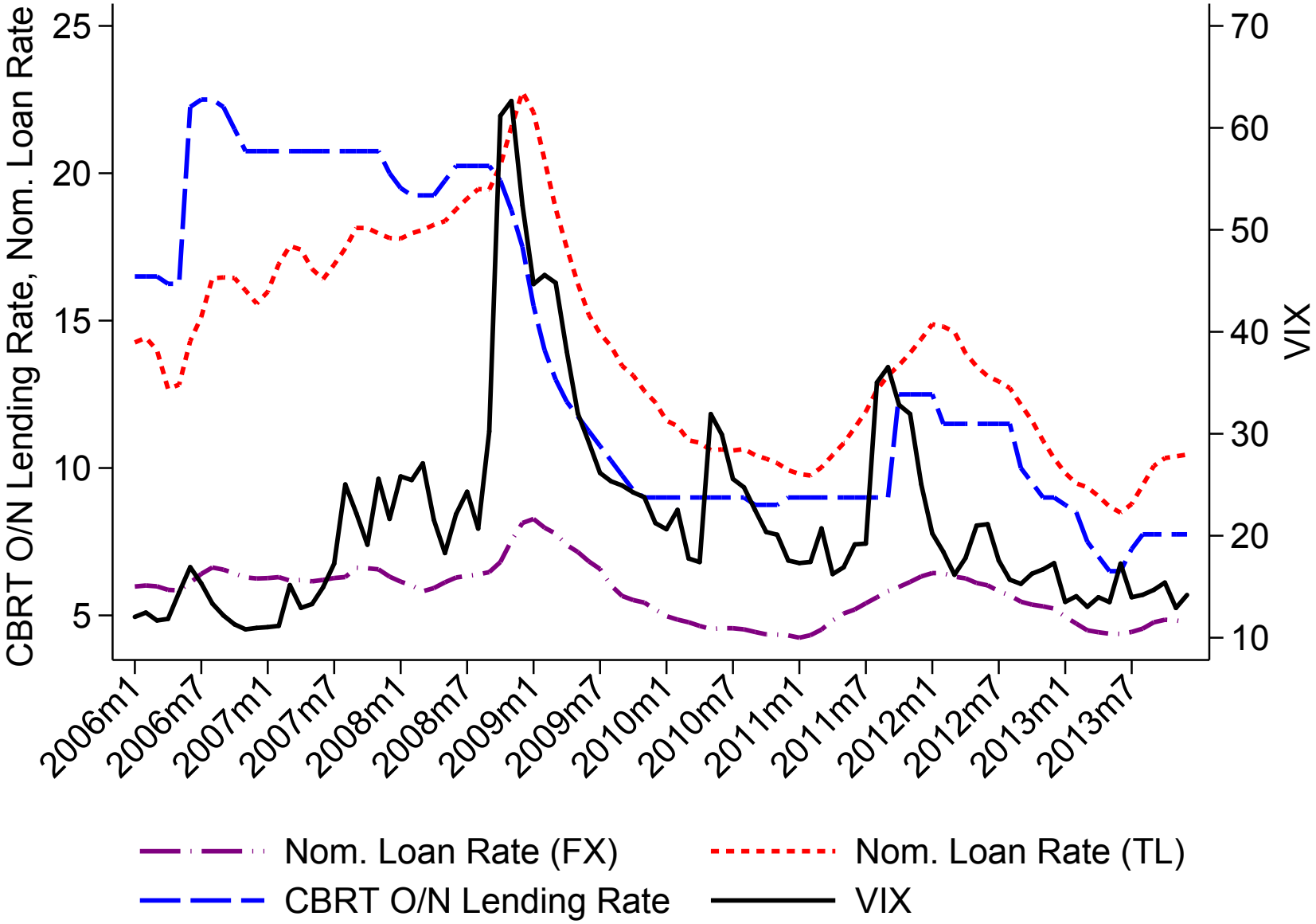
FX and TL Loan Growth in Turkey



Sources: CBRT. Data Summary

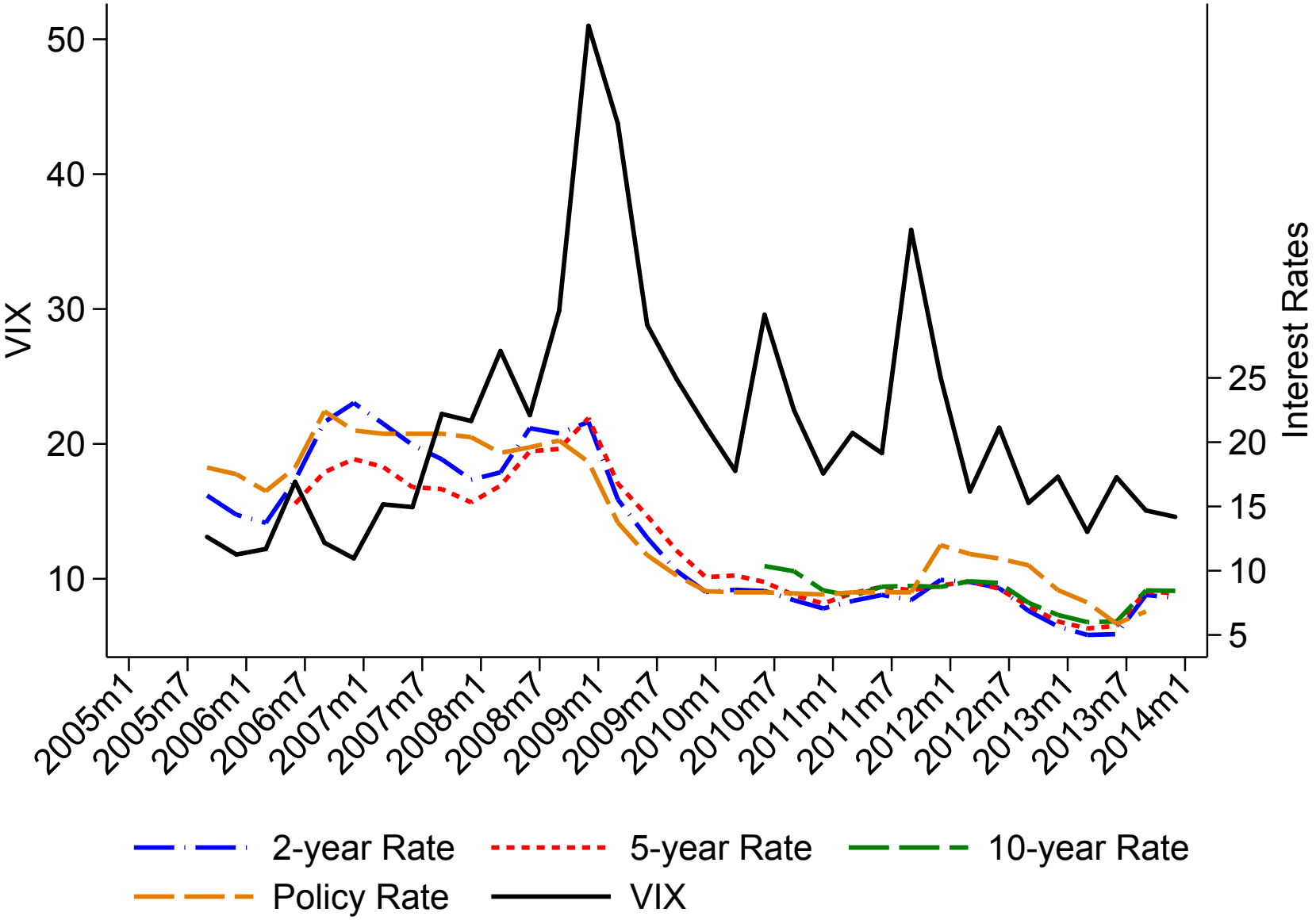
Policy Rate, Average Lending Rates, and VIX

◂ Macro regressions



Long-Term Rates

Macro regressions



Impact of VIX's Spillovers on Real Borrowing Costs by Bank Type

	Bank Type			
	Commercial	Comm. + State	Domestic	Foreign
	(1)	(2)	(3)	(4)
$\log(\text{VIX}_{q-1})$	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

Reduced-form regressions

Macro Regression Robustness

- Add firm×year effects.
- Decompose VIX into volatility and risk aversion.
- Use only firms who borrow from multiple banks in a quarter.
- Separate short and long term maturity loans.
- Control for LT rates.
- Pre-post GFC/VIX spike.
- Control for exchange rate level and expectations.

◂ Reduced-form regressions

Heterogeneity: Differences-in-Differences

$$\log \mathrm{Y}_{f,b,d,q} = \alpha_{b,q} + \alpha_{f,q} + \kappa(\mathrm{Noncore}_b \times \mathrm{NetWorth}_f \times \log \mathrm{VIX}_{q-1}) + \delta_2 \mathrm{FX}_{f,b,d,q} + \vartheta_{f,b,d,q},$$

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

- $\mathrm{Noncore}_b$: non-core liabilities ratio (0 = "low," 1 = "high").
- $\mathrm{NetWorth}_f$: firm net worth: (0 = "low," 1 = "high").
- FX: foreign currency indicator (0 = TL, 1 = FX).
- $\alpha_{f,q}$: firm×quarter effect; fully controls time varying firm unobservables.
- $\alpha_{b,q}$: bank×quarter effect; fully controls time varying bank unobservables.
- **Macro** controls are in the quarter fixed effect.

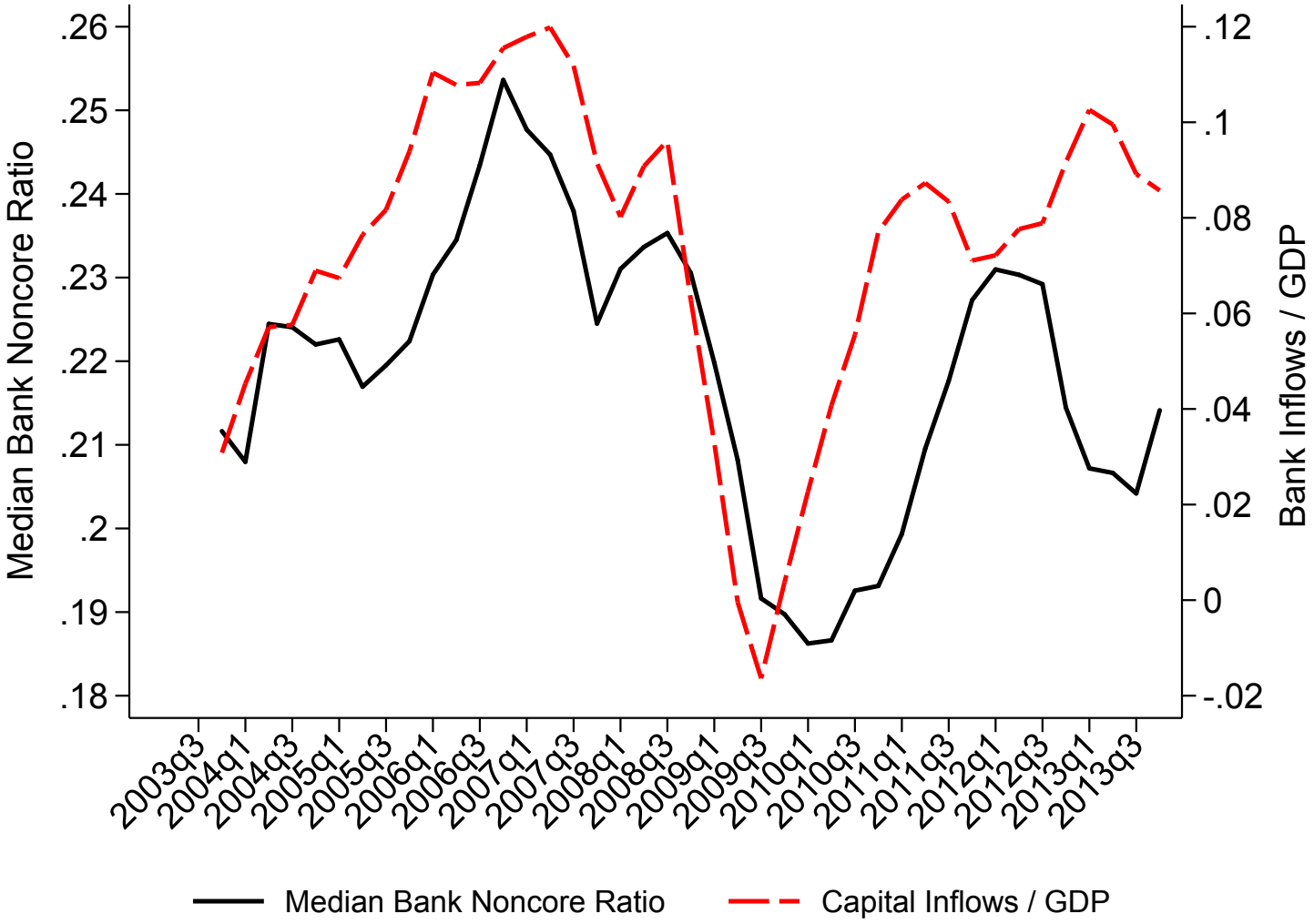
◂ Heterogeneity results

Heterogeneity Regressions

	log(Loans$_q$)			log(1+r_q)		
	(1)	(2)	(3)	(4)	(5)	(6)
Noncore$_b$×log(VIX$_{q-1}$)	-0.035^b			0.015^a		
	(0.017)			(0.004)		
Noncore$_b$×NetWorth$_f$×log(VIX$_{q-1}$)		-0.004			-0.005^a	
		(0.020)			(0.001)	
Noncore$_b$×FX×log(VIX$_{q-1}$)			-0.007			-0.012^a
			(0.018)			(0.004)
FX	0.690^a	0.802^a	0.745^a	-0.079^a	-0.078^a	-0.042^c
	(0.013)	(0.019)	(0.095)	(0.003)	(0.004)	(0.021)
Observations	9,280,825	1,281,369	9,280,825	9,280,825	1,281,369	9,280,825
R-squared	0.876	0.764	0.877	0.852	0.814	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

Heterogeneity results

Capital Flows and Non-Core Liabilities



Heterogeneity results

Issuance Regressions: Within Firm-Bank Estimator

Identify from within variation in loans given a firm-bank pair.

Firm f's new loan l and month m from bank b (in FX or TL):

$$\begin{aligned}\log \mathrm{Y}_{f,b,l,m} = \omega_{f,b,m} &+ \beta_1 \mathrm{Collateral}_{f,b,l,m} + \beta_2(\mathrm{Collateral}_{f,b,l,m} \times \log \mathrm{VIX}_{m-1}) \\ &+ \beta_3(\mathrm{Noncore}_b \times \mathrm{Collateral}_{f,b,l,m}) \\ &+ \beta_4(\mathrm{Noncore}_b \times \mathrm{Collateral}_{f,b,l,m} \times \log \mathrm{VIX}_{m-1}) \\ &+ \beta_5 \mathrm{FX}_{f,b,l,m} + e_{f,b,l,m},\end{aligned}$$

where 'Collateral' is the loan's collateral-to-principal ratio, and $\omega_{f,b,m}$ is a configuration of firm-bank-month effects.

Further control for other loan-level characteristics (maturity, subjective risk, sectoral use...).

Loan-Level Results

★ Loan level collateral constraints are not related to firm and bank factors.
★ Interest rate-collateral relation does not respond to VIX once firm factors are controlled for.

	log(Loans$_m$)				log(1+r_m)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Collateral/Loan	0.106^a	0.089^a	0.091^a	0.090^a	-0.002^a	-0.004^a	-0.004^a	-0.0003
	(0.005)	(0.010)	(0.011)	(0.004)	(0.001)	(0.001)	(0.001)	(0.0003)
Collateral/Loan×log(VIX$_{m-1}$)	0.019^c	0.025^c	0.030^b	0.056^a	-0.004^a	-0.0002	0.002	-0.002^a
	(0.010)	(0.013)	(0.015)	(0.008)	(0.001)	(0.001)	(0.002)	(0.001)
Noncore$_b$×Collateral/Loan				-0.013				-0.014^a
				(0.038)				(0.003)
Noncore$_b$×Collateral/Loan×log(VIX$_{m-1}$)				-0.204^a				0.015^a
				(0.030)				(0.003)
FX	0.441^a	0.488^a	0.560^a	0.560^a	-0.082^a	-0.080^a	-0.082^a	-0.082^a
	(0.019)	(0.038)	(0.048)	(0.048)	(0.002)	(0.003)	(0.004)	(0.004)
Observations	16,578,790	11,618,529	10,096,917	10,096,917	16,578,790	11,618,529	10,096,917	10,096,917
R-squared	0.738	0.840	0.851	0.851	0.657	0.844	0.861	0.863
Bank×firm F.E.	Yes	Yes	No	No	Yes	Yes	No	No
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Risk F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maturity F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	No	No	No	Yes	No	No	No
Firm×month F.E.	No	Yes	No	No	No	Yes	No	No
Bank×firm×month F.E.	No	No	Yes	Yes	No	No	Yes	Yes

◂ Heterogeneity results

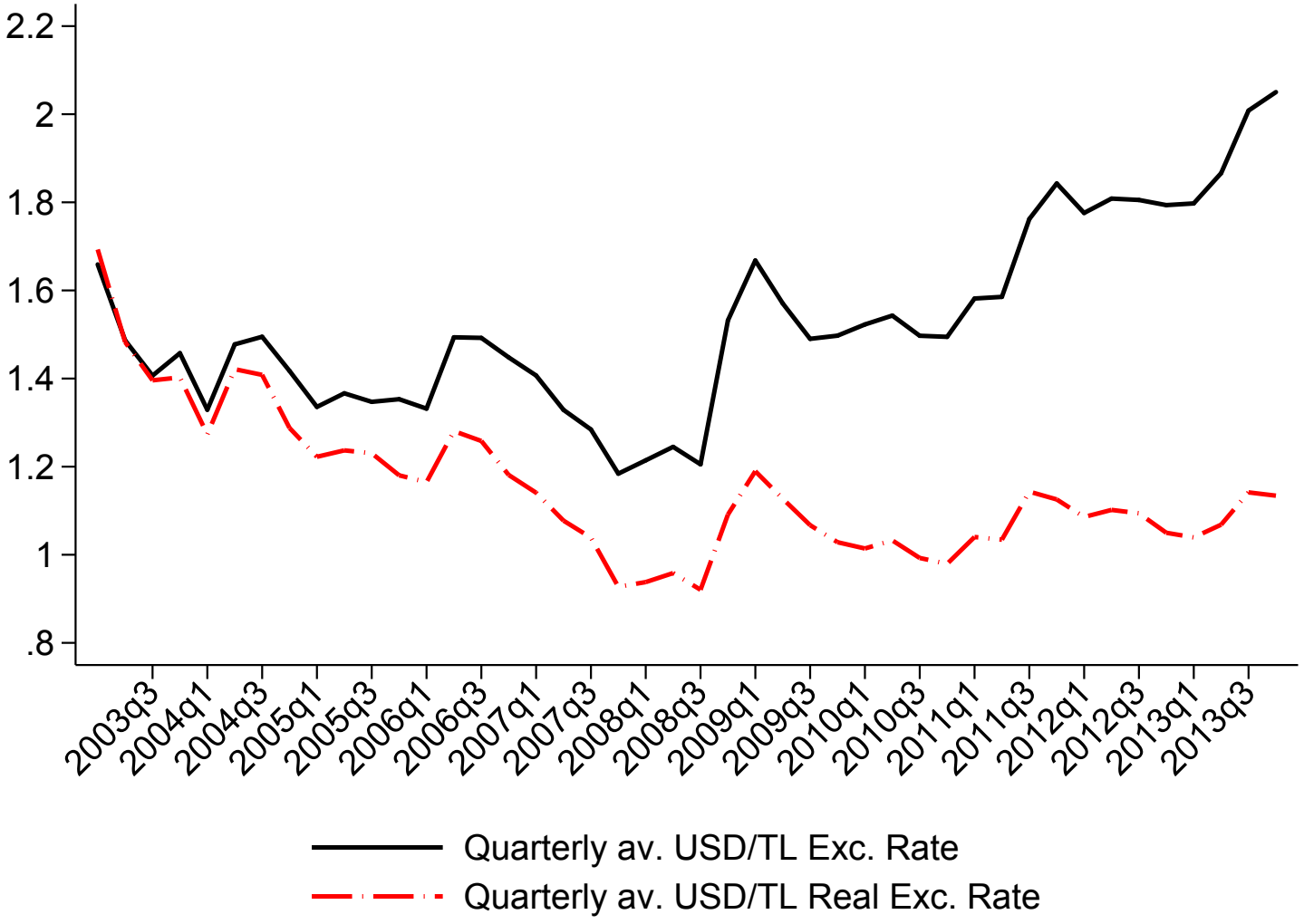
VIX and the Exchange Rate Risk-Taking Channels

	$\log(\text{Loans}_q)$		$\log(1+r_q)$	
	(1)	(2)	(3)	(4)
$\text{Leverage}_b \times \text{FXshare}_f \times \log(\text{VIX}_{q-1})$	0.041		-0.003	
	(0.032)		(0.002)	
$\text{Leverage}_b \times \text{FXshare}_f \times \log(\text{XR}_{q-1})$		-0.392^a		-0.006
		(0.107)		(0.006)
FX	0.688^a	0.688^a	-0.079^a	-0.079^a
	(0.013)	(0.013)	(0.003)	(0.003)
Observations	9,280,825	9,280,825	9,280,825	9,280,825
R-squared	0.877	0.877	0.877	0.877
Bank×firm F.E.	Yes	Yes	Yes	Yes
Firm×quarter F.E.	Yes	Yes	Yes	Yes
Bank×quarter F.E.	Yes	Yes	Yes	Yes

Heterogeneity results

Exchange Rates

vis-à-vis the USD



◂ Heterogeneity results