



FEDERAL RESERVE BANK *of* NEW YORK

# The shifting drivers of global liquidity

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The views expressed are those of the author and do not necessarily represent those of the Federal Reserve Bank of New York, Federal Reserve System, or Bank for International Settlements

# The Big Picture

- Pre-Global Financial Crisis
  - Sharp growth in International capital flows.
  - Strong international co-movement of prices, flows
  - Broad-based growth in bank-to-bank lending
- Post-GFC, sharply different patterns
  - Cross-border bank lending retrenched (Bussiere et al 2016)
    - ✓ Rebalancing across lending banking systems
  - Contraction in interbank lending especially notable
    - ✓ Intra-bank held up better than inter-bank (Reinhardt Riddiough (2015))
  - International bond market financing increased
    - ✓ “The Second Phase of Global Liquidity” (Shin 2013)
    - ✓ Increase in roles of nonbanks (IMF GFSR 2016)

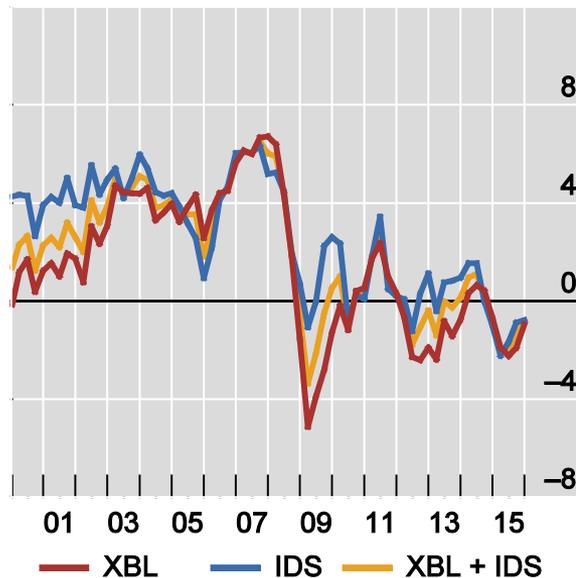
# External debt flows from borrower perspective: loans v. bonds

External debt flows, all borrowers

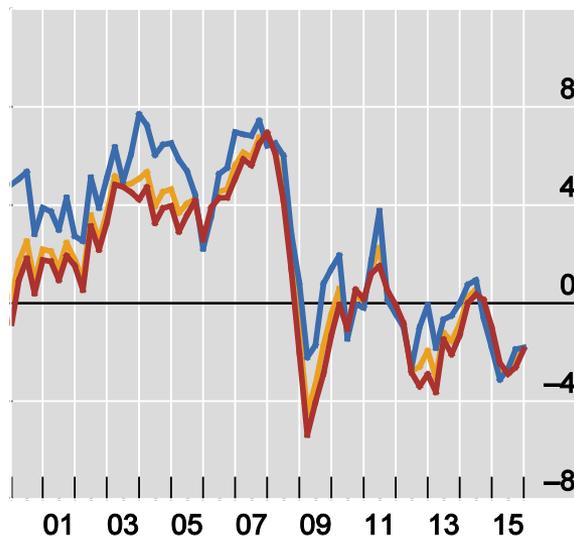
Four-quarter moving average of quarterly growth rates, in per cent

Graph 2

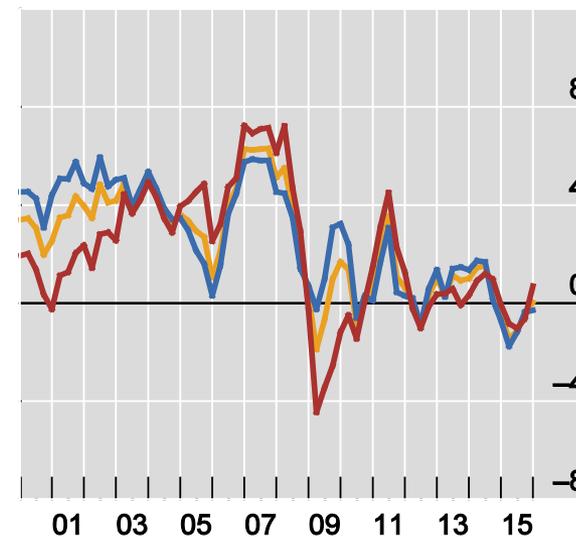
All sectors



Banks



Non-banks

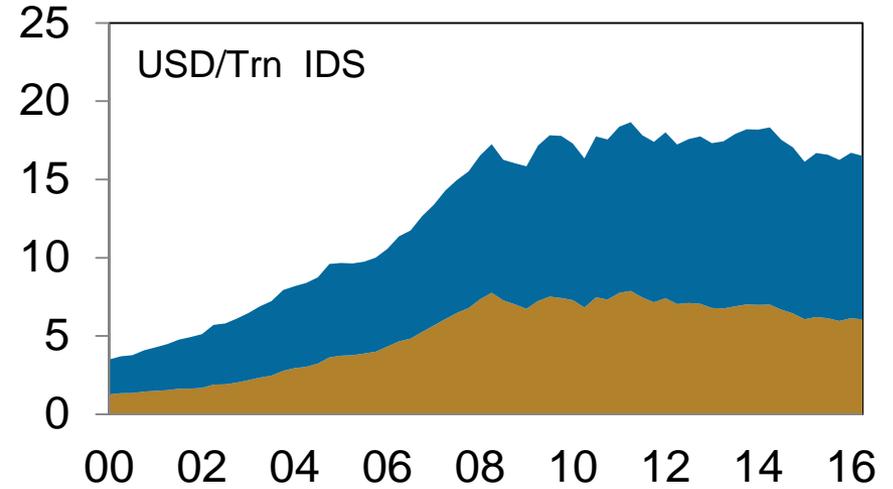
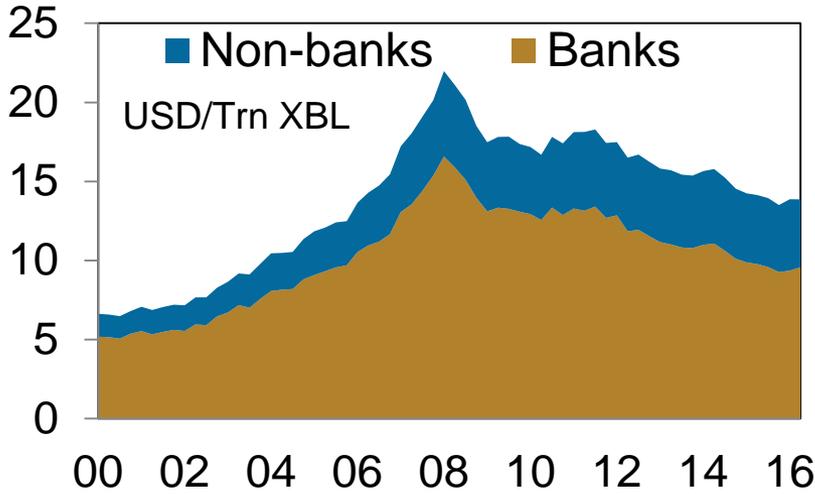


XBL = Cross-border loans: Quarterly Growth Rate<sub>t</sub> = (Outstanding Stock<sub>t</sub> / Outstanding Stock<sub>t-1</sub>)-1; IDS = International Debt Securities: Quarterly Growth Rate<sub>t</sub> = (Outstanding Stock<sub>t</sub> / Outstanding Stock<sub>t-1</sub>)-1.

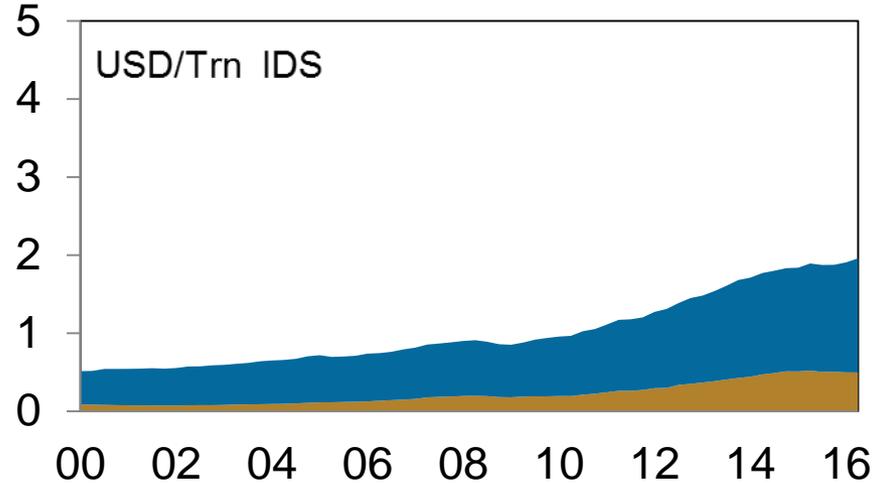
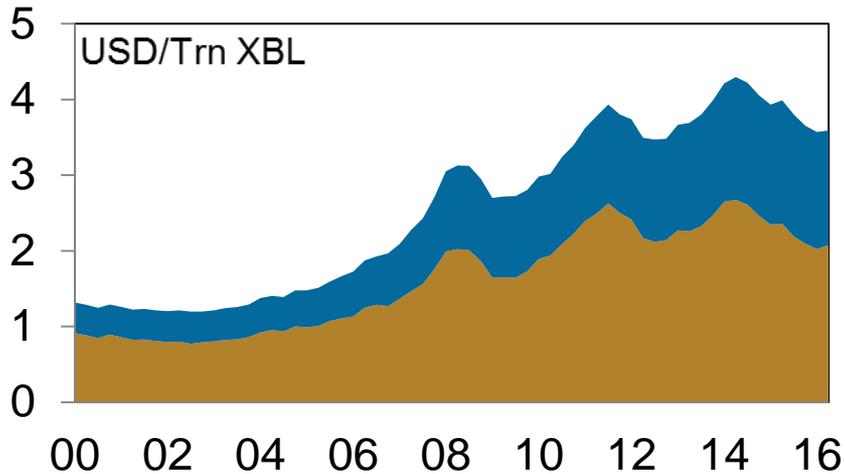
Sources: BIS Locational Banking Statistics by residence; BIS International Debt Securities Statistics.

# Outstanding cross-border loans & international debt securities

## AE borrowers



## EM Borrowers



# Different institutions are involved in types of flows

## XBL and IDS, typical lenders and borrowers

	<b>Typical Lenders</b>	<b>Typical Borrowers</b>	<b>Notes</b>
<b>XB loans to banks</b>	Internationally-active banks	Banks (all sizes)	<i>Interbank market (unsecured and repo)</i>
<b>XB loans to nonbanks</b>	Internationally-active banks	Large non-financial corporates; exporting/importing firms; Leveraged non-bank financials	<i>Syndicated loan market; trade credit; project financing</i>
<b>IDS issued by banks</b>	Pension funds; Insurance companies; MMMFs; Hedge funds	Large and mid-sized banks	<i>Smaller investor base than for IDS issued by non-banks</i>
<b>IDS issued by non-banks</b>	Pension funds; Insurance companies; MMMFs; Hedge funds	Non-financial corporates; governments; Insurance companies	<i>Broader investor base than for IDS issued by banks</i>

# Main questions around types of financial intermediaries and global liquidity drivers

- Are the main drivers of international bank loan flows different from those of international bond flows?
- Have the sensitivities to global drivers evolved since the GFC?
  - ✓ Are capital flows more stable and less prone to sharp reversals since GFC?
- What are the reasons behind the shifts in sensitivities?
  - ✓ Role of regulatory changes, bank balance sheet condition, composition of creditors, stance and type of monetary policy?
  - ✓ Which factors and effects are more likely to persist?

# Main questions

- Are the main drivers of international bank loan flows different from those of international bond flows?

Yes.

US MP and VIX for loan flows.

Pre-crisis, mainly VIX for IDS.

# Main questions around global liquidity drivers

- Have the sensitivities to global drivers evolved since the GFC?

Yes, a lot.

- US monetary policy effects: stronger for both loan and bond flows
- Global risk effects: weaker for loans; stronger for bonds
- Convergence in sensitivities between loan and bond flows
- Very large changes up through 2013, followed by partial reversion afterwards

Are capital flows more stable and less prone to sharp reversals since GFC?

- Shift to bond financing could have led to more stability.
- Post GFC, NO. Sum of compositional and behavioral changes.
- Looking forward? Maybe, if some structural changes persist.

# Main questions around global liquidity drivers

- What are the reasons behind the shifts in sensitivities to US MP?

Both the composition of “country-bank” lending systems and the behavior of lenders have evolved

- Market share increased for lower sensitivity banking systems
  - These were the ex ante better capitalized systems
- Banking systems more broadly increased sensitivity to global factors
  - More of an evolution for the ex ante weakly capitalized lenders

Further evolutions occurred during the post GFC period

- Weak role for banks business model and profitability (which also may be stressed in low policy rate periods)
- Strong role for degree of monetary policy convergence, so that response to US policy largest when policy of AEs converges, weaker on divergence

Literature

# Existing literature on international capital flows, global liquidity drivers, international spillovers

- IMF GFSR, BIS QRs, Financial Stability Reports...
- Milesi-Ferretti and Tille (2011)
- Forbes and Warnock (2012)
- Fratzscher (2012)
- Cerutti, Claessens and Ratnovski (2014)
- Bruno and Shin (2015)
- Correa, Paligorova, Sapriza and Zlate (2015)
- Rey (2015)
- Miranda-Agrippino and Rey (2015)
- McCauley, McGuire, Sushko (2015)
- Chari, Dilts-Stedman and Lundblad (2017)
- Main global drivers of international capital flows:
  - **Global Risk** Conditions, **AE Monetary policy**, **Global Growth**
  - **Local factors:** own policy, institutions, economic conditions, capital controls, sovereign risk

# Data and empirical approach

# Empirical Approach

- **Part 1: Global Liquidity Drivers from borrowing country perspective**
  - Estimate impact of global (VIX, FFR) and local drivers of capital flows
    - ✓ Cross-border loans (BIS LBSR), International debt securities (BIS IDSS)
    - ✓ 2000:Q1 to 2015:Q4, 64 countries
    - ✓ Shadow policy rate used for FFR
  - Endogenously identify structural break points
  - Document (pre- vs post-break) shifts in sensitivities
  - Document time variation in post crisis sensitivity
- **Part 2: Decomposition of pre-post changes**
  - Introduce lending bank nationality dimension (BIS CBS)
    - ✓ Controls for heterogeneity across lenders
  - Examine role of change in composition versus behavior of lenders
  - Identify the main determinants of the lender-specific shifts
    - ✓ Balance sheet condition, Prudential policy actions
- **Part 3: Explain Post-crisis time variation in US MP effect**
  - Changing lender balance sheets: stress, reach for yield (NIMs, capital)
  - Signal value of US MP (lower when AE policy divergence)

# Part 1: Empirical Methodology

- Conduct analysis for different types of flows, corresponding to different borrower types and creditor types
- Baseline estimation by borrowing country j:

$$GrRateY_t^j = \beta_1 \Delta FFR_t + \beta_2 \log VIX_t + \beta_3 \Delta \log GlobalGDP_t + \beta_4 \Delta \log GDP_t^j + \beta_5 \Delta SovRating_t^j + \beta_6 ChinnIto_t^j + \mu^j + \varepsilon_t^j$$

*Wu-Xia shadow rate for 2009:q1-2015:Q4*

- Endogenously identify **structural break points** [Bai (1997), Kurozumi (2002)]
  - Strong evidence of structural breaks in Q1/2009.
- Benchmark estimation with structural breaks:
  - $GrRateY_t^j = \beta' X_t^j + \mu^j + I(t \geq T_{break}^Y)(\kappa + \gamma' X_t^j) + \varepsilon_t^j$

# Baseline model confirms findings of prior literature

Explanatory variables	Dependent variable: $\Delta$ Cross-border loans from banks			Dependent variable: $\Delta$ International debt securities		
	All	to banks	to non-banks	All	by banks	by non-banks
$\Delta$ Fed funds rate	<b>-1.95***</b>	<b>-2.48***</b>	<b>-1.86***</b>	<b>-1.76***</b>	<b>-2.26**</b>	<b>-1.44**</b>
Log(VIX)	<b>-2.75***</b>	<b>-2.51***</b>	<b>-3.10***</b>	<b>-2.31***</b>	<b>-5.22***</b>	<b>-1.49*</b>
$\Delta$ Real GDP	0.53***	0.57***	0.50***	0.09	0.21	0.08
$\Delta$ Sovereign rating	2.80***	4.37***	0.03	0.56	-1.50	0.29
Chinn-Ito index	-1.35	-3.03	0.30	8.11***	10.72**	4.87
$\Delta$ Real global GDP	0.50***	0.81***	0.34**	0.00	-0.18	-0.15
Observations	3,327	3,327	3,327	3,327	2,961	3,326
R-squared	0.11	0.07	0.07	0.05	0.03	0.03

# Benchmark model with structural breaks

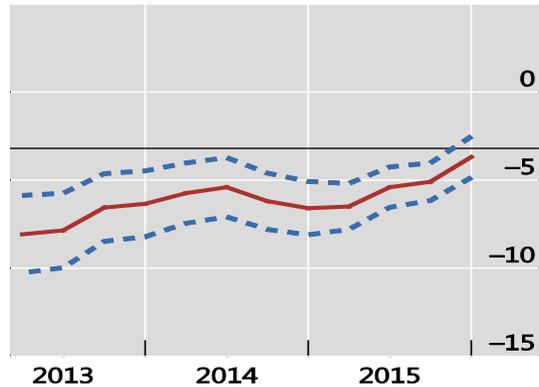
Explanatory Variables		Dependent variable: $\Delta$ Cross-border loans		Dependent variable: $\Delta$ International debt securities	
		To banks	To non-banks	By banks	By non-banks
$\beta_1$	$\Delta$ Fed funds rate				
	Pre-break	<b>-3.44***</b>	<b>-3.42***</b>	-1.26	-0.90
	Post-break	<b>-5.56***</b>	<b>-2.29***</b>	<b>-9.82***</b>	<b>-4.88***</b>
$\beta_2$	Log(VIX)				
	Pre-break	<b>-4.43***</b>	<b>-4.36***</b>	<b>-5.63**</b>	-0.21
	Post-break	0.77	-0.99	-1.25	-0.83

# Change in sensitivities to FFR, pre v post-break & over time

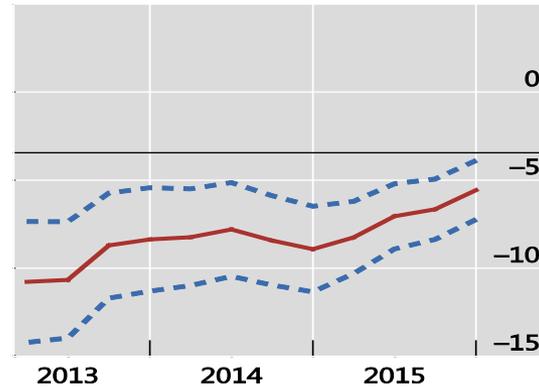
Taper tantrum period:  
peak sensitivity!

Post-break sensitivities to  $\Delta$ FFR, evolution over time

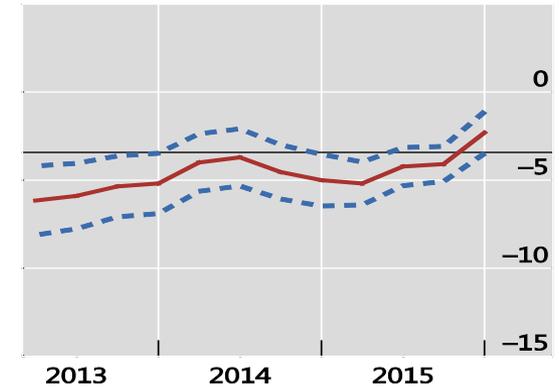
Cross border loans to all



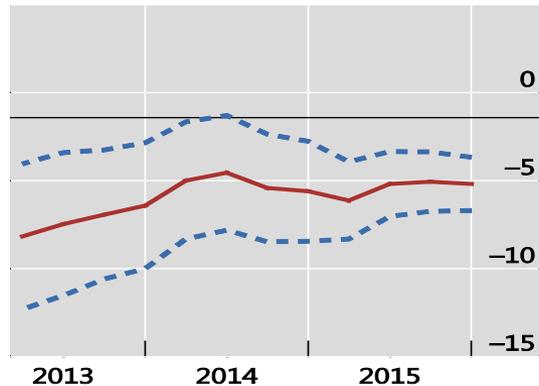
Cross border loans to banks



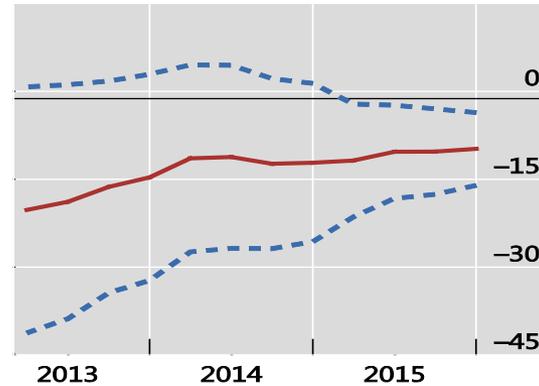
Cross border loans to non-banks



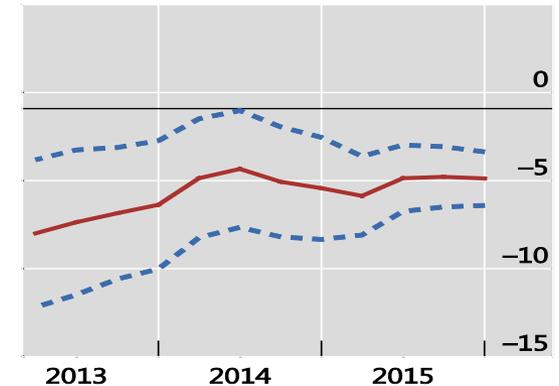
IDS issued by all



IDS issued by banks



IDS issued by non-banks



— estimate  
 - - - Lower 90%  
 - - - Upper 90%

The graph shows the evolution over time of sensitivities to the  $\Delta$ FFR. For each quarter  $t$ , the charts show the post-break coefficient (and its 90% confidence interval) obtained by estimating the model with a sample from 2000:Q1 up to quarter  $t$ , with a break in 2009:Q1. The model includes the  $\log(\text{VIX})$ ,  $\Delta$ Real GDP,  $\Delta$ Sovereign Ratings, Chinn-Ito Index,  $\Delta$ Real Global GDP,  $\Delta$ FFR (i.e.  $\Delta$ Effective federal funds rate for the period 2001:Q1 – 2008:Q4,  $\Delta$ Wu-Xia Shadow rate for the period 2009:Q1 – 2015:Q4) as explanatory variables. The black line in each panel represents the pre-break estimate of the sensitivity to  $\Delta$ FFR.

# Convergence between loan and bond sensitivities?

- Once diverse sensitivities converged after GFC, and then reversed for FFR.

	Coefficients (XBL) – Coefficients (IDS)		
	<i>Borrower sector</i>		
	All	Banks	Non-banks
<i>Pre-break</i>			
Log(VIX)	-2.85**	1.20	-4.14**
ΔFed funds rate	-1.77*	-2.18*	-2.52**
<i>Post-break (up to 2013:Q1)</i>			
Log(VIX)	0.40	3.47	-0.35
ΔFed funds rate	0.10	9.47	1.84
<i>Post-break (up to 2015:Q4)</i>			
Log(VIX)	1.23	2.02	-0.15
ΔFed funds rate	1.51*	4.25	2.59**

## Decomposition of pre-post changes

# Decomposing the post-crisis shifts in sensitivities

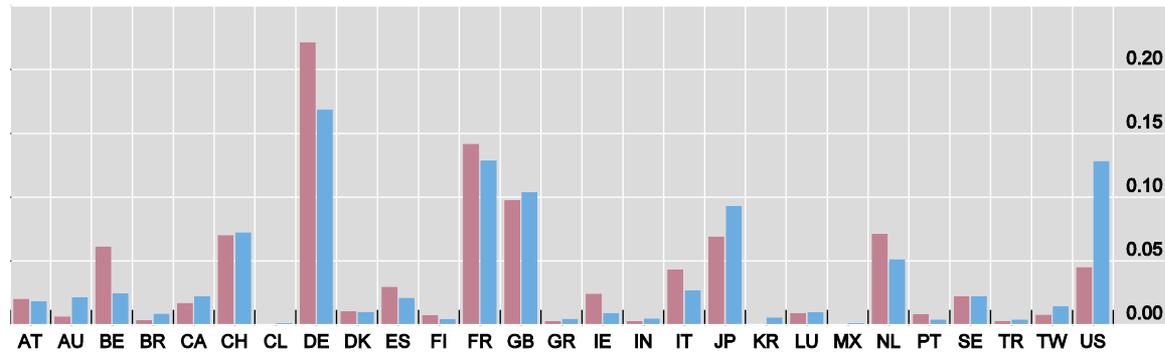
- From a borrower's perspective, shifts in sensitivities may be driven by:
  - changes in **composition** of lenders (compositional component).
  - changes in **sensitivities** of lenders (behavioral component).
- Sensitivities to global factors ( $\beta_k$ ) can be expressed as weighted averages of the respective lender-specific sensitivities ( $\beta_k^i$ ).
- $\Delta\beta_k$  has a **behavioral component** and a **compositional component**:

$$\Delta\beta_k = \sum_i \{ (\Delta\beta_k^i) \cdot w_{pre}^i + (\Delta w^i) \cdot \beta_{k,pre}^i \}$$

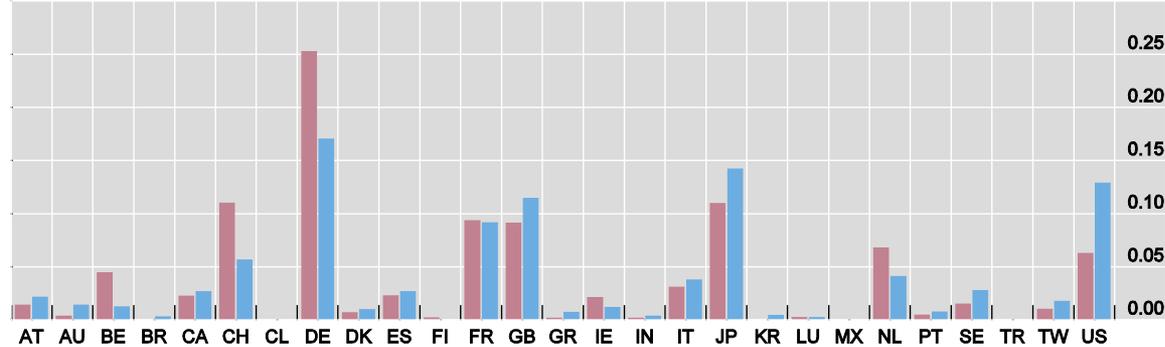
- The BIS CBS contains information on:
  - The country of the borrower, nationality of lending banking system

Re-estimate all specifications using the bilateral CBS data to get lender sensitivities. Compute weights of bank lenders.

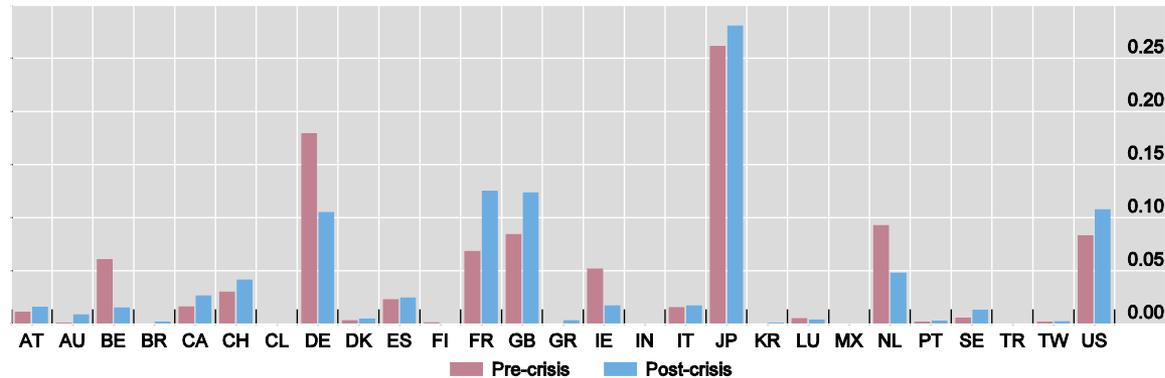
Banks



Non-bank private sector



Public sector



Sources: BIS consolidated banking statistics; authors' calculations.

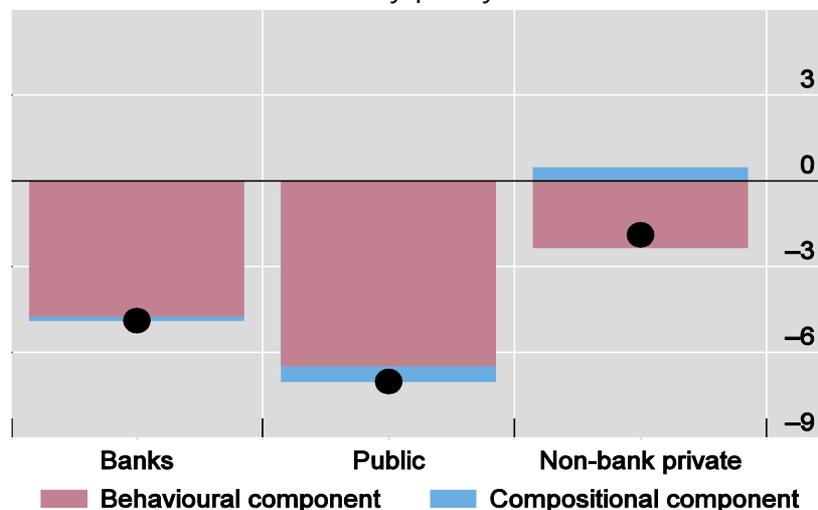
# Decomposing the shifts in sensitivities to US MP

- **Behavioral component** (lender-specific sensitivities)
  - **main driver** of shifts in sensitivities to US MP
  - **increases** (the absolute values of) the estimated **sensitivities**.
- **Compositional component** (lender weights)
  - **decreases** (the absolute values of) the estimated **sensitivities**.
  - **relatively small contributions**, dominated by the behavioral component.

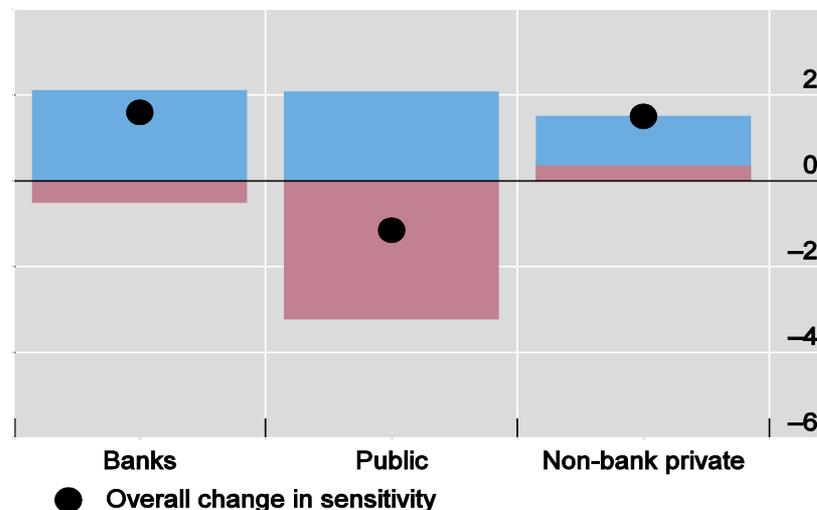
Decomposing the shifts in lender-specific sensitivities, by borrowing sector

Graph 4

Sensitivities to US monetary policy



Sensitivities to the VIX



Sources: BIS consolidated banking statistics; authors' calculations.

# Determinants of shifts in lender-specific sensitivities

- Weakly capitalised banking systems, with smaller banks, became more responsive to global factors.

Explanatory Variables	Dependent variable: Structural change in the coefficient for $\Delta$ Fed funds rate $\beta_1^{PostBreak} - \beta_1^{PreBreak}$			Dependent variable: Structural change in the coefficient for Log(VIX) $\beta_2^{PostBreak} - \beta_2^{PreBreak}$		
	(I)	(II)	(III)	(IV)	(V)	(VI)
<b>Pre-break Capital ratio</b>	<b>0.41**</b>	<b>0.31*</b>	<b>0.35*</b>	<b>0.53**</b>	<b>0.67***</b>	<b>0.46**</b>
<b>Pre-break Average bank size</b>	<b>1.38***</b>	<b>1.46***</b>	<b>1.29**</b>	-0.76	-0.82	-0.56
Pre-break Prudential index	-0.47			0.57		
Pre-break LTV index		-1.27			-0.87	
Pre-break Local reserve requirement index			-0.83			3.30***
Sectoral fixed effects	yes	yes	yes	yes	yes	yes
Observations	87	87	87	87	87	87
Q	279.40	285.30	286.30	256.60	254.90	236.50
Degrees of Freedom test Q	81	81	81	81	81	81
$I^2$	0.71	0.72	0.72	0.68	0.68	0.66
$\tau^2$	14.67	15.47	15.51	32.73	32.31	26.24
Adjusted R-squared	20.51	17.81	17.72	17.76	16.81	28.76

# Determinants of the shifts in lender-specific weights

- Gain in market share by banking systems with ex-ante:
  - higher **capitalization** ratios
  - larger **deposits** funding shares
  - greater role of **local affiliates** in lending

Dependent variable:  
Change in the lending national banking system weights  
 $W^{Postbreak} - W^{PreBreak}$

Explanatory variables	(I)	(II)	(III)	(IV)	(V)	(VI)
<b>Pre-break Capital ratio</b>	<b>0.001*</b>	<b>0.001**</b>	<b>0.001*</b>	<b>0.002*</b>	<b>0.002**</b>	<b>0.001*</b>
Pre-break Average bank size	0.003	0.003	0.003	0.005	0.004	0.004
Pre-break Prudential index	-0.001			-0.003**		
Pre-break LTV index		-0.001			-0.004*	
<b>Pre-break Local reserve requirement index</b>			<b>0.005**</b>			<b>0.005**</b>
<b>Pre-break Deposits to total funding ratio</b>				<b>.0004**</b>	<b>.0002**</b>	<b>.0001**</b>
<b>Local claims over Foreign claims</b>				<b>0.025*</b>	<b>0.029*</b>	<b>0.034**</b>
Sectoral fixed effects	yes	yes	yes	yes	yes	yes
Observations	87	87	87	75	75	75
Adjusted R-squared	0.05	0.04	0.07	0.14	0.11	0.13

# Exploration of drivers of post-crisis sensitivities

# What drives changes in sensitivities of lenders (behavioral component)?

- Increased sensitivity to USMP (and then retrenchment) may be due to
  - reach for yield, especially by banks in low NIM and low capitalization states, or
  - enhanced signal by US rate of other key policy rates in the early post crisis period
- Introduce interactions directly into baseline model with structural breaks:
  - MP divergence between the US and other AEs
    - ✓ (2-year futures contract on FFR) minus (average of similar future contracts for the UK, Switzerland, Japan, and a group of 'core' Eurozone countries)
  - a proxy for the lending banking systems business models
    - ✓ Income diversification ratio, defined as net interest income to total income or net interest income to total assets

Variables	Mean	Std. Dev.	Min	Max
<i>Lenders' balance sheet characteristic</i>				
Net interest income to total assets	0.63	0.50	-3.81	2.96
<i>Monetary policy divergence proxy</i>				
Spread on 2-year futures on the policy rate	1.05	0.76	0.01	3.00

# Monetary policy divergence and banking net interest share in time varying sensitivities

Explanatory variables	Dependent Variable: Cross-border loans			Dependent Variable: International debt securities		
	All	to banks	to non-banks	All	by banks	by non-banks
<i>Post-break</i>						
$\Delta$ FFR	<b>-8.41***</b>	<b>-11.19***</b>	<b>-7.16***</b>	<b>-7.16**</b>	-23.63	<b>-6.79**</b>
Log(VIX)	<b>-4.78***</b>	<b>-4.04</b>	<b>-4.27***</b>	<b>-5.77**</b>	<b>-12.57**</b>	<b>-5.24*</b>
$\Delta$ FFR*Net interest to TA	-1.20	2.79	-3.24	<b>8.30*</b>	<b>30.28*</b>	7.62
Log(VIX)*Net interest to TA	1.24	2.27	-0.62	6.30	11.99	7.22
$\Delta$ FFR*Policy divergence	<b>8.59***</b>	<b>7.30**</b>	<b>10.21***</b>	0.39	4.09	0.76
Log(VIX)*Policy divergence	<b>10.26***</b>	<b>10.95***</b>	<b>8.28***</b>	3.46	14.97	3.34
Observations	3,327	3,327	3,327	3,327	2,961	3,326
R-squared	0.18	0.12	0.11	0.08	0.05	0.05

## Residual time variation remains on FFR sensitivity, even after controlling for MP divergence and banking net interest share

Explanatory variables	Dependent Variable: Cross-border loans			Dependent Variable: International debt securities		
	All	to banks	to non-banks	All	by banks	by non-banks
<i>Post-break minus pre-break coefficients</i>						
$\Delta$ Fed funds rate	-10.35***	-13.47***	-7.644***	-3.92	-24.53	-7.05
Log(VIX)	-1.54	0.89	-3.64	9.98**	-1.09	5.16

Wrap up

## Concluding remarks

### Composition of global liquidity has **changed post-crisis**

From borrower perspective, sensitivities to global liquidity drivers evolved:

- **More responsive** to changes in **US MP**
  - ✓ **mainly due to behavioral** changes by lending banking systems rather than shifts in composition of lenders
- Converging responsiveness of bank and market finance
- **Largest changes** in bank lending to the **public sector**

Banking systems with ex-ante weaker **capitalization** and less **deposit** funding:

- Lost market share
- Changed behaviors the most

Going forward, structural changes in lending banking systems and AE policy divergence may mean less flighty international capital flows.



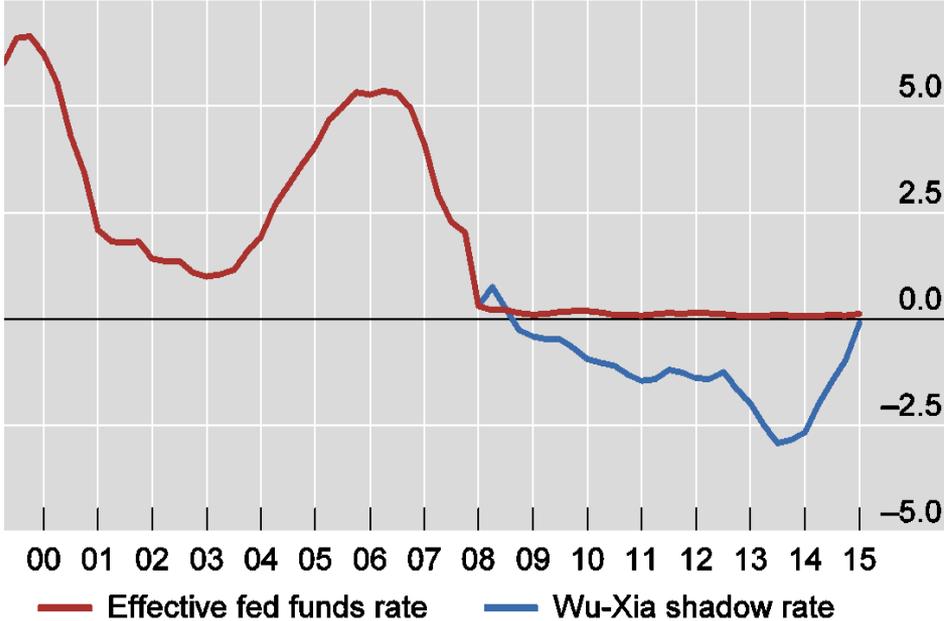
**Thank you!**

Graph 2

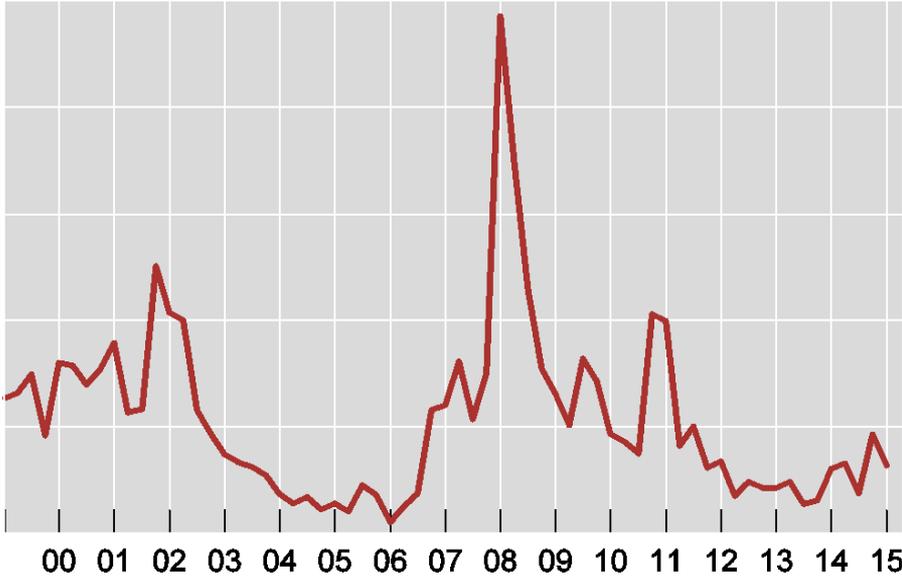
US policy rates and the VIX

Graph

US policy rates



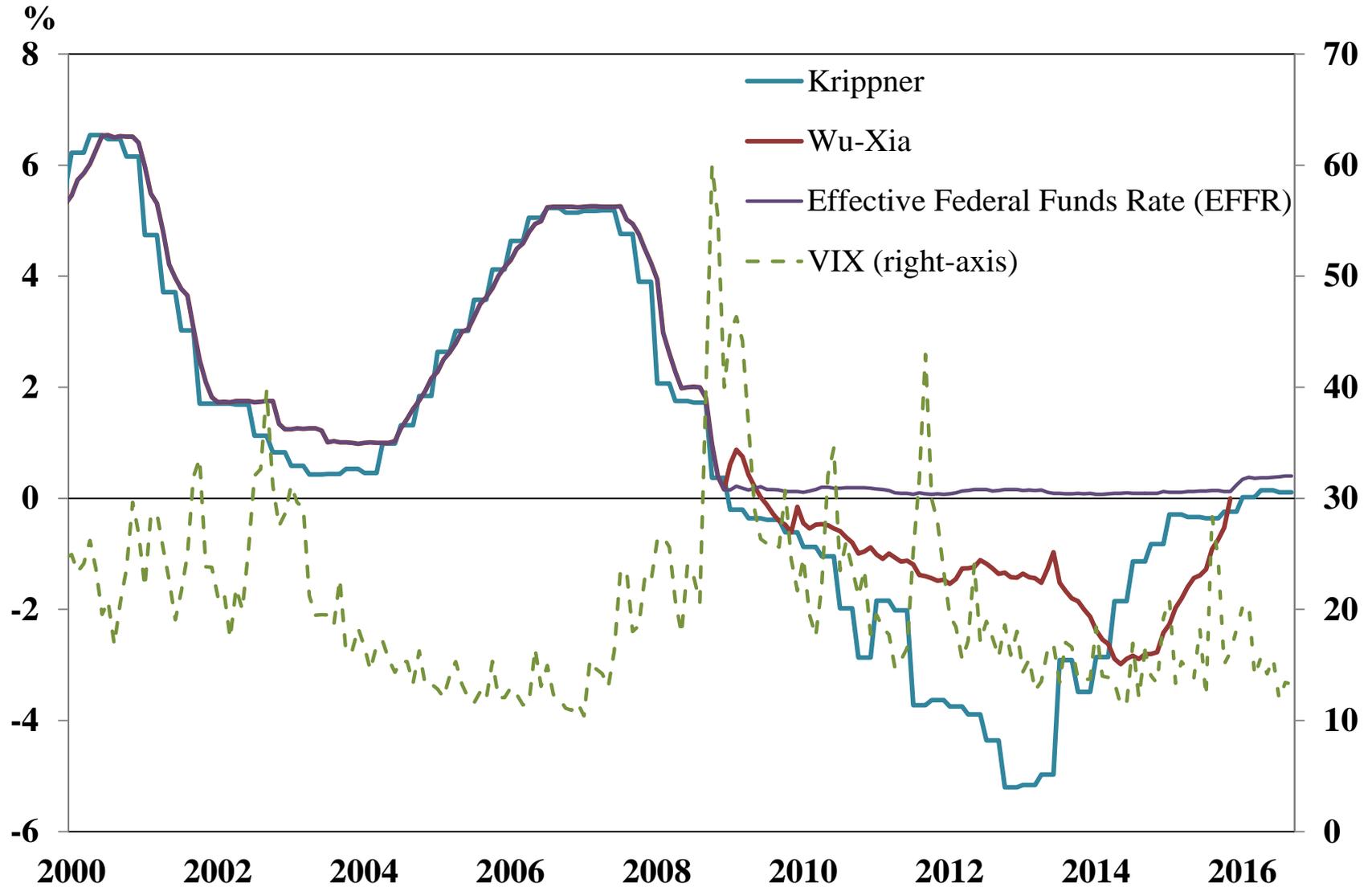
VIX



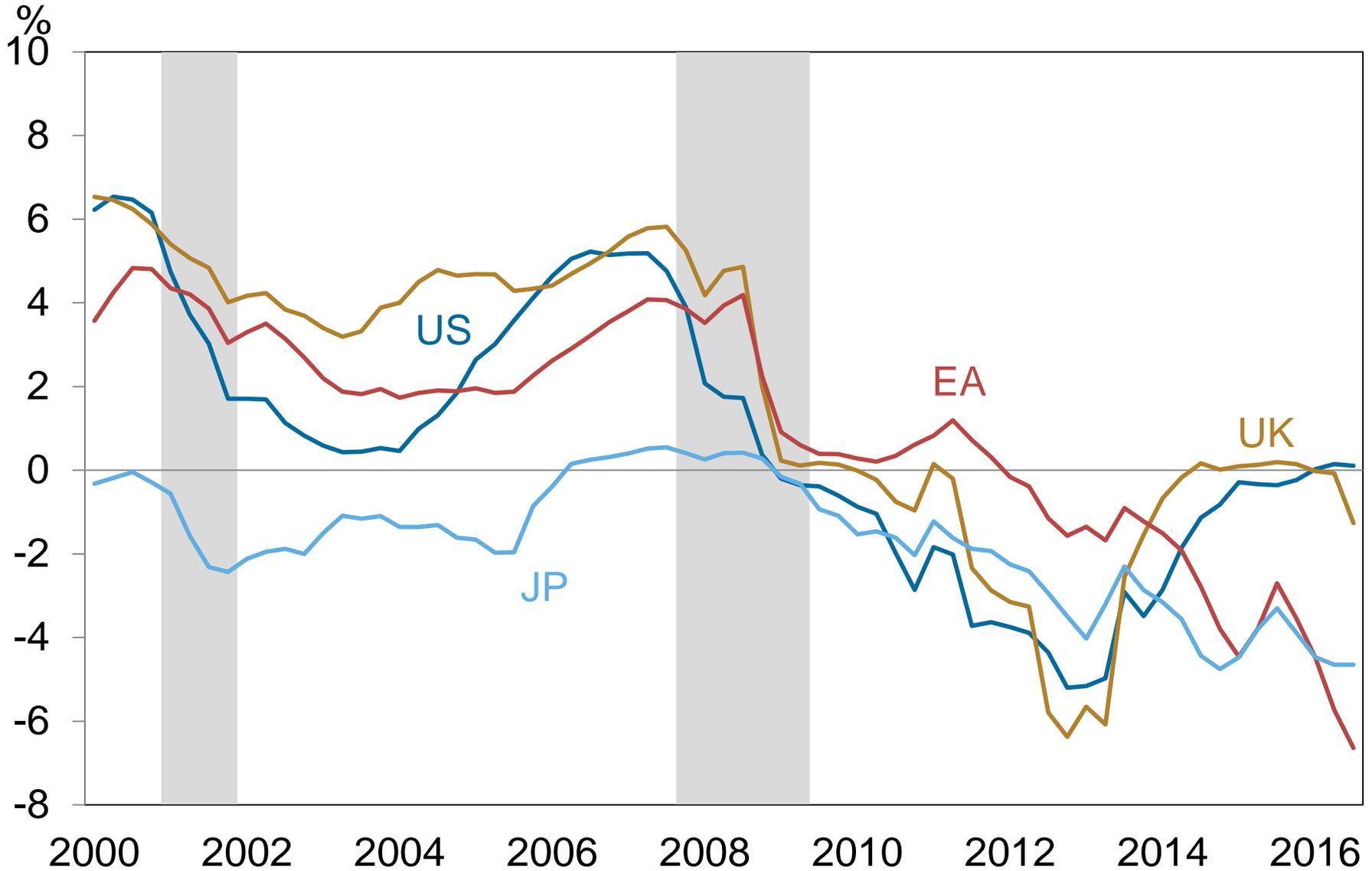
Sources: Wu and Xia (2015); Datastream.

Unlike the observed short-term interest rate, the shadow rate—first introduced by [Fischer Black \(1995\)](#)—is *not* bounded below by 0 percent. Whenever the Wu-Xia shadow rate is above 1/4 percent, it is exactly equal to the model implied one-month interest rate by construction. The input data for the model are one-month forward rates beginning  $n$  years hence. Wu and Xia use forward rates corresponding to  $n = 1/4, 1/2, 1, 2, 5, 7,$  and  $10$  years. These forward rates are constructed with end-of-month Nelson-Siegel-Svensson yield curve parameters from the [Gurkaynak, Sack, and Wright \(2006\)](#) dataset. In short, the shadow rate is assumed to be a linear function of three latent variables called factors, which follow a VAR(1) process. The latent factors and the shadow rate are estimated with the extended Kalman filter.

# EFFR versus Shadow Rates versus VIX



# Krippner Shadow Monetary Policy Rate



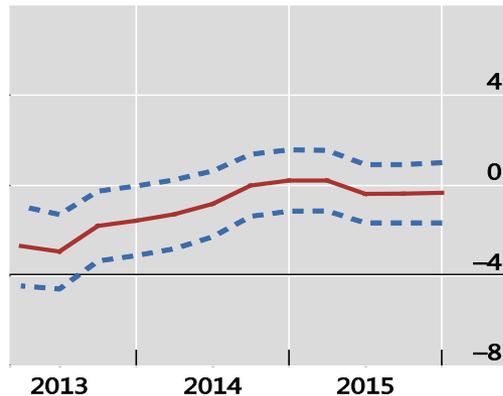
Source: Leo Krippner, 2012

Note: Shading shows NBER recessions

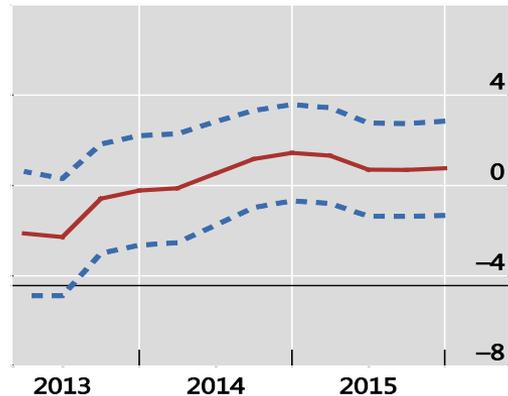
# Change in sensitivities to VIX, pre v. post-break & over time

Post-break sensitivities to  $\log(\text{VIX})$ , evolution over time

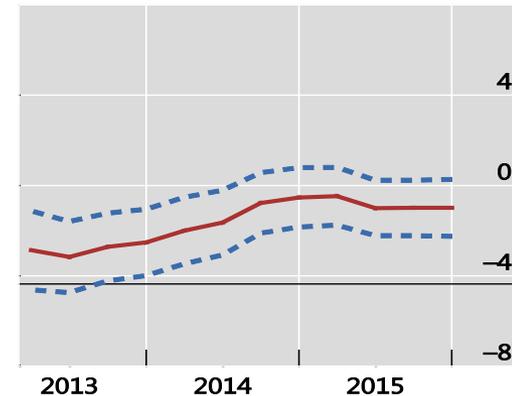
Cross border loans to all



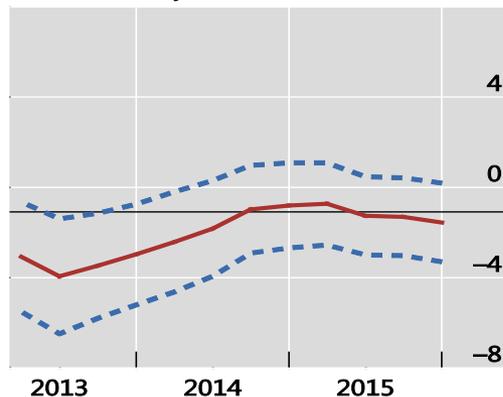
Cross border loans to banks



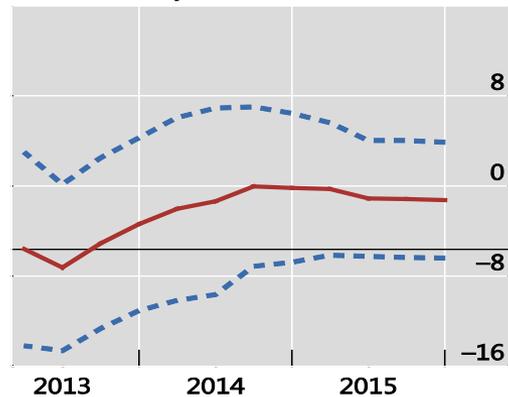
Cross border loans to non-banks



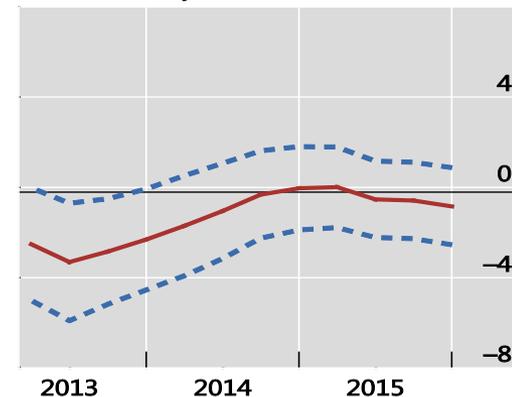
IDS issued by all



IDS issued by banks



IDS issued by non-banks



Confidence limit:  
— estimate    - - - Lower 90%  
- - - Upper 90%

The graph shows the evolution over time of sensitivities to the  $\log(\text{VIX})$ . For each quarter  $t$ , the charts show the post-break coefficient (and its 90% confidence interval) obtained by estimating the model with a sample from 2000:Q1 up to quarter  $t$ , with a break in 2009:Q1. The model includes the  $\log(\text{VIX})$ ,  $\Delta\text{Real GDP}$ ,  $\Delta\text{Sovereign Ratings}$ , Chinn-Ito Index,  $\Delta\text{Real Global GDP}$ ,  $\Delta\text{FFR}$  (i.e.  $\Delta\text{Effective federal funds rate}$  for the period 2001:Q1 – 2008:Q4,  $\Delta\text{Wu-Xia Shadow rate}$  for the period 2009:Q1 – 2015:Q4) as explanatory variables. The black line in each panel represents the pre-break estimate of the sensitivity to the  $\log(\text{VIX})$ .

## Country lists

### **Borrowing countries (64)**

Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, China, Colombia, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hong Kong, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Japan, Korea, Kuwait, Latvia, Lebanon, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Mongolia, Netherlands, New Zealand, Nigeria, Norway, Peru, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Taiwan, Thailand, Turkey, Ukraine, United Kingdom, United States, Uruguay, Vietnam.

### **CBS lending bank nationalities (31)**

Australia, Austria, Belgium, Brazil, Canada, Chile, Denmark, Finland, France, Germany, Greece, Hong Kong, India, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, Netherlands, Norway, Panama, Portugal, Singapore, Spain, Sweden, Switzerland, Taiwan, Turkey, United Kingdom, United States.

# Descriptive Statistics of the Explanatory Variables

Variables	Obs.	Mean	Std. Dev.	Min	Max
<i>Global factors</i>					
$\Delta$ Fed fund rates (1)	4,069	-0.08	0.52	-1.73	1.00
Log (VIX)	4,006	2.96	0.34	2.40	4.07
$\Delta$ Global GDP	4,069	3.66	1.67	-2.49	5.75
<i>Country-specific variables</i>					
$\Delta$ GDP	3,658	3.15	3.91	-19.30	28.10
$\Delta$ Sovereign ratings (2)	3,901	0.01	0.26	-4.67	2.43
Chinn-Ito index (3)	3,872	0.74	0.32	0.00	1.00
<i>Prudential tools (4)</i>					
PruC (5)	3,840	0.05	0.39	-1.00	1.00
LTV (6)	1,298	0.04	0.27	-1.00	1.00
ResReq (7)	3,840	-0.01	0.32	-3.00	5.00
CapReq (8)	3,420	0.03	0.17	0.00	1.00
CumPruC (9)	3,584	0.58	3.42	-9.00	25.00
CumLTV (10)	1,149	0.47	1.73	-3.00	8.00
CumCapReq (11)	3,192	0.16	0.41	0.00	2.00
CumResReq (12)	3,584	-0.49	1.98	-7.00	13.00

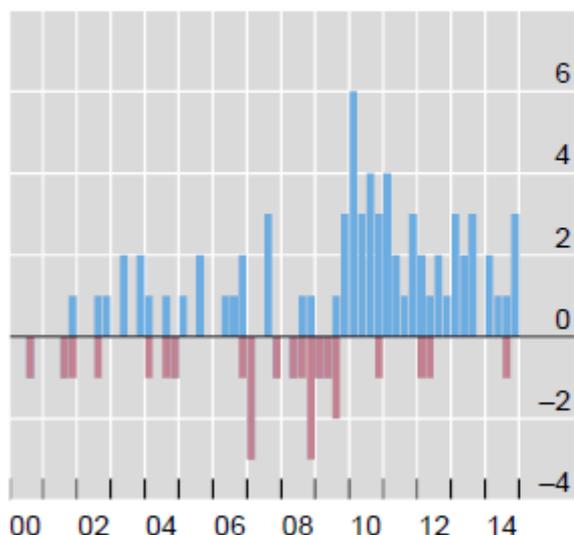
Notes: The sample includes quarterly data for 64 recipient countries over the period 2000:Q1 - 2015:Q4, except for the prudential tools for which the data end in 2014:Q4. (1) Effective federal funds rate for the period 2001:Q1 - 2008:Q4, Wu-Xia Shadow rate for the period 2009:Q1 - 2015:Q4. (2) LT foreign currency, average across 3 agencies. (3) Chinn and Ito (2006) measure of financial openness. (4) A higher prudential index indicates a tightening. (5) Composite prudential index. (6) Caps on loan to value ratio. (7) Reserve requirements in local currency. (8) Capital requirements. (9) Cumulative composite prudential index. (10) Cumulative caps on loan to value ratio. (11) Cumulative reserve requirements in local currency. (12) Cumulative capital requirements. Each cumulative prudential index is obtained in each quarter by adding the non-cumulative prudential index up to that quarter.

# Examining the role of prudential actions

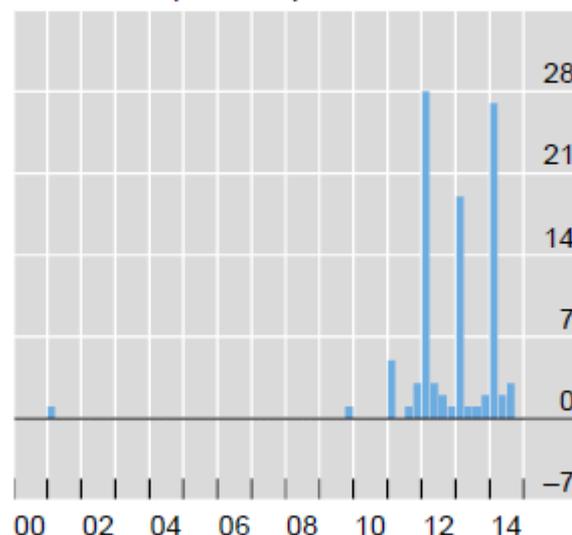
- Database on Changes in Prudential Policy Instruments – collaboration between IMF and IBRN
  - Cerutti, Correa, Fiorentino and Segalla (2015)
- We focus on three types of prudential instruments (impulse and cumulative)

## Changes in prudential policies

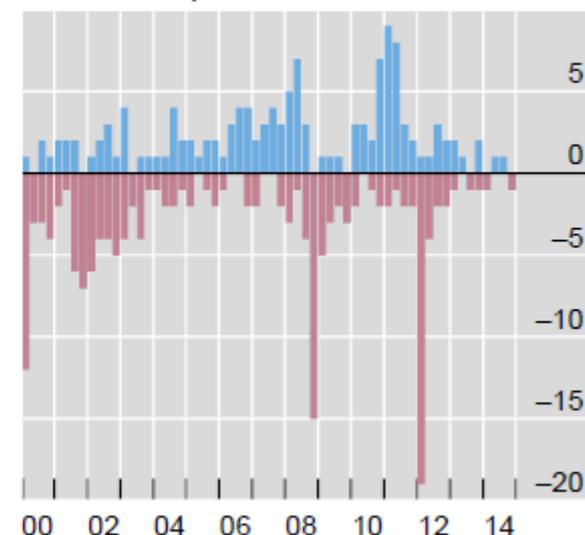
Loan to value ratio limits



General capital requirements



Reserve requirements (local)



Source: Cerutti et al (2015).

**Robustness**

# Locational baseline regressions (by borrowing country) with alternative shadow rates

Explanatory variables	Dependent variable: $\Delta$ Cross-border loans <sup>†</sup>			Dependent variable: $\Delta$ International debt securities <sup>‡</sup>		
	All	to banks	to non-banks	All	by banks	by non-banks
<b><math>\Delta</math>Krippner (1)</b>	-1.12***	-0.77**	-1.21***	-0.81	-1.72**	-0.74
Log(VIX)	-3.87***	-2.88**	-4.29***	-2.85***	-7.47***	-2.09**
$\Delta$ Real GDP	0.57***	0.61***	0.53***	0.17*	0.23	0.17
$\Delta$ Sovereign rating (2)	2.11**	3.55**	-0.67	1.10	-1.94	0.86
Chinn-Ito index (3)	-0.59	-1.88	1.08	8.43***	12.32**	5.03
$\Delta$ Real global GDP	0.22	0.52**	0.09	-0.28	-0.57	-0.43
Observations	3,115	3,115	3,115	3,115	2,765	3,114
R-squared	0.11	0.07	0.07	0.06	0.03	0.04

Notes: The sample includes quarterly data on cross-border flows (loans and debt securities) for 64 recipient countries over the period 2000:Q1 - 2014:Q4. The regressions include a full set of country fixed effects. Robust standard errors in parentheses. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ . <sup>†</sup> to borrowers in country  $j$ . <sup>‡</sup> issued by borrowers in country  $j$ . (1) Krippner (2005) estimate of the Fed fund shadow rate. (2) LT foreign currency, average across 3 agencies. (3) Chinn and Ito (2006) measure of financial openness.

## Locational baseline regressions (by borrowing country) with alternative shadow rates

Explanatory variables	Dependent variable: $\Delta$ Cross-border loans <sup>†</sup>			Dependent variable: $\Delta$ International debt securities <sup>‡</sup>		
	All	to banks	to non-banks	All	by banks	by non-banks
<b><math>\Delta</math>Bauer-Rudebush (4)</b>	-1.78***	-1.84***	-1.99***	-2.04**	-0.24	-1.78***
Log(VIX)	-3.34***	-2.99***	-3.77***	-3.04***	-4.72**	-3.34***
$\Delta$ Real GDP	0.58***	0.61***	0.53***	0.17*	0.23	0.58***
$\Delta$ Sovereign rating (2)	2.18**	3.65***	-0.59	1.21	-2.03	2.18**
Chinn-Ito index (3)	-0.61	-1.96	1.05	8.35***	12.40**	-0.61
$\Delta$ Real global GDP	0.33**	0.60**	0.21	-0.20	-0.39	0.33**
Observations	3,115	3,115	3,115	3,115	2,765	3,115
R-squared	0.11	0.08	0.07	0.06	0.03	0.11

Notes: The sample includes quarterly data on cross-border flows (loans and debt securities) for 64 recipient countries over the period 2000:Q1 - 2014:Q4. The regressions include a full set of country fixed effects. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. <sup>†</sup> to borrowers in country j. <sup>‡</sup> issued by borrowers in country j. (1) Krippner (2005) estimate of the Fed fund shadow rate. (2) LT foreign currency, average across 3 agencies. (3) Chinn and Ito (2006) measure of financial openness. (4) Bauer-Rudebusch (2015) estimate of the Fed fund shadow rate.

## Baseline model with 2-year US rates instead of shadow rates

Explanatory variables	Dependent variable: $\Delta$ Cross-border loans <sup>†</sup>			Dependent variable: $\Delta$ International debt securities <sup>‡</sup>		
	All	to banks	to non-banks	All	by banks	by non-banks
$\Delta$ Fed funds rate (1)	-1.62***	-0.95	-2.42***	-0.14	-0.19	-0.17
Log(VIX)	-2.63***	-1.46	-3.67***	-1.25	-3.85*	-0.73
$\Delta$ Real GDP	0.54***	0.61***	0.47***	0.10	0.20	0.10
$\Delta$ Sovereign rating (2)	2.70**	4.19***	0.07	0.50	-1.36	0.20
Chinn-Ito index (3)	-1.75	-3.69	0.29	7.90***	9.95**	4.84
$\Delta$ Real global GDP	0.37**	0.62***	0.25	-0.06	-0.19	-0.23
Observations	3,327	3,327	3,327	3,327	2,961	3,326
R-squared	0.11	0.07	0.07	0.05	0.03	0.03

Notes: The sample includes quarterly data on cross-border flows (loans and debt securities) for 64 recipient countries over the period 2000:Q1 - 2015:Q4. The regressions include a full set of country fixed effects. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. <sup>†</sup> to borrowers in country j. <sup>‡</sup> issued by borrowers in country j. (1) Two-year Treasury rate. (2) LT foreign currency, average across 3 agencies. (3) Chinn and Ito (2006) measure of financial openness.

## Baseline model with structural breaks and 2-year US rates instead of shadow rates

	Dependent variable: $\Delta$ Cross-border loans <sup>†</sup>			Dependent variable: $\Delta$ International debt securities <sup>‡</sup>		
	All	to banks	to non-banks	All	by banks	by non-banks
<i>Pre-break</i>						
Log(VIX)	-2.24***	-1.43	-3.29***	-0.07	-0.88	0.02
$\Delta$ Fed funds rate (1)	-4.13***	-3.687*	-5.38***	0.04	-5.43	0.45
<i>Post-break</i>						
Log(VIX)	-3.76	-7.65**	-0.24	1.82	-11.64	-2.22
$\Delta$ Fed funds rate (1)	-0.85	-0.39	-0.92	-0.90	-2.92	-0.99
Obs.	3,327	3,327	3,327	3,327	2,961	3,326
R <sup>2</sup>	0.15	0.09	0.10	0.06	0.03	0.04

Notes: The sample includes quarterly data on cross-border flows (loans and debt securities) for 64 recipient countries over the period 2000:Q1 - 2015:Q4. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. <sup>†</sup> to borrowers in country j. <sup>‡</sup> issued by borrowers in country j. <sup>1</sup> 2-year Treasury rate. The regressions include DReal GDP, DSovereign Ratings, Chinn-Ito Index, DReal Global GDP and their interaction with a break dummy that takes value 1 after the break date (2009:Q1). The regressions also include a full set of country fixed effects.

# Baseline model with structural breaks and alternative measures of portfolio debt flows

Explanatory variables	All	Dependent variable: $\Delta$ Portfolio debt flows <sup>†</sup>	
		to banks	to non-banks
<i>Pre-break</i>			
Log(VIX)	0.00	-1.13	-0.55
$\Delta$ Fed funds rate (1)	-0.57	-2.34	-1.01
<i>Post-break</i>			
Log(VIX)	-5.37***	-4.67***	-5.14***
$\Delta$ Fed funds rate (1)	-1.26**	-2.90***	-0.69
Observations	2,592	2,447	2,592
R-squared	0.14	0.10	0.11

Notes: The sample includes quarterly data on cross-border flows (loans and debt securities) for 64 recipient countries over the period 2000:Q1 - 2015:Q4. Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. . <sup>†</sup> growth rate of outstanding stocks of debt issued by borrowers in country j, winsorized at the 10% level. (1) Effective federal funds rate for the period 2001:Q1 – 2008:Q4, Wu-Xia Shadow rate for the period 2009:Q1 – 2015:Q4. The regressions include  $\Delta$ Real GDP,  $\Delta$ Sovereign Ratings, Chinn-Ito Index,  $\Delta$ Real Global GDP and their interaction with a break dummy that takes value 1 after the break date (2009:Q1). The regressions also include a full set of country fixed effects.

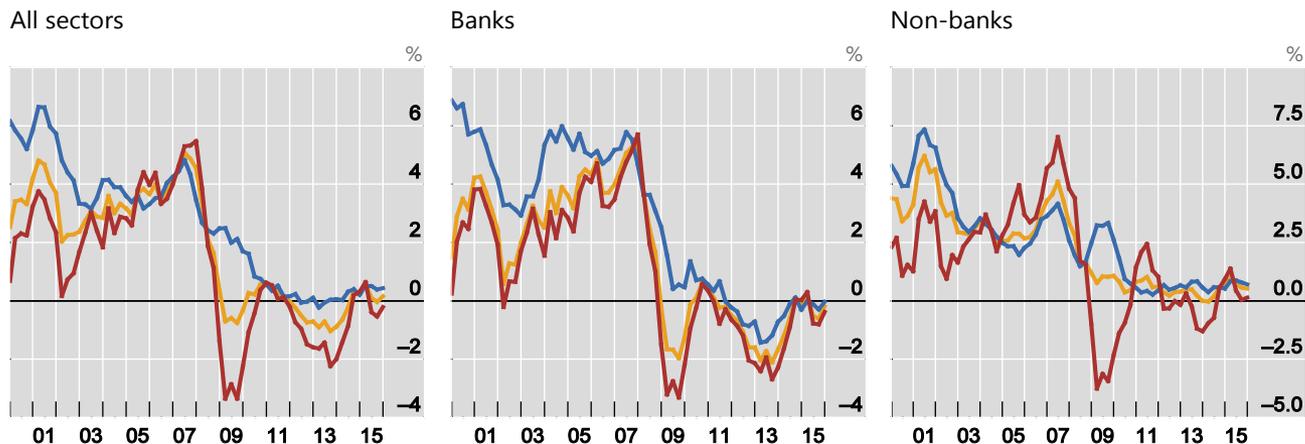
# **Advanced economies versus emerging market economies**

# External Debt Flows: AE versus EME Borrowers

External debt flows, AE borrowers

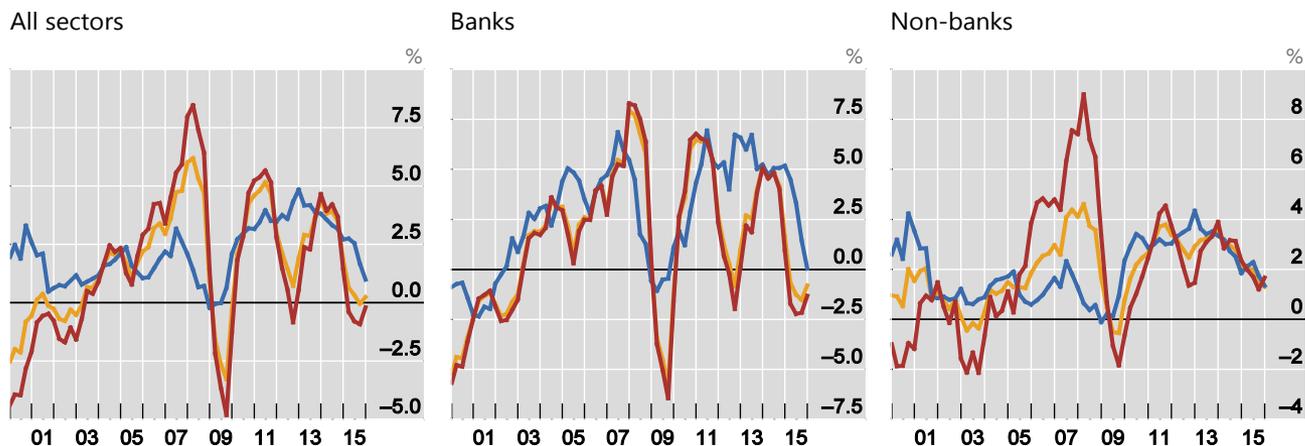
Four-quarter moving average of quarterly growth rates

Graph C1



External debt flows, EME borrowers

Graph C2



XBL = Cross-border loans: Quarterly Growth Rate<sub>t</sub> = Adjusted Flows<sub>t</sub> / Outstanding Stock<sub>t-1</sub>; IDS = International Debt Securities: Quarterly Growth Rate<sub>t</sub> = Net Issuance<sub>t</sub> / Outstanding Stock<sub>t-1</sub>.

Sources: BIS Locational Banking Statistics by residence; BIS International Debt Securities Statistics.

# Summary statistics

		Mean			Standard deviation		
		XBL	IDS	XBL+IDS	XBL	IDS	XBL+IDS
Pre-crisis	All	2.51	3.79	3.02	3.44	1.48	2.18
	AE	2.66	4.02	3.21	3.63	1.62	2.30
	EME	1.61	1.42	1.55	4.22	1.68	3.00
Post-crisis	All	-0.58	0.72	0.05	1.70	0.84	0.92
	AE	-1.09	0.52	-0.27	1.65	0.92	0.91
	EME	2.39	3.47	2.70	3.90	1.23	2.85

XBL = Cross-border loans: Quarterly Growth Rate<sub>t</sub> = Adjusted Flows<sub>t</sub> / Outstanding Stock<sub>t-1</sub>; IDS = International Debt Securities: Quarterly Growth Rate<sub>t</sub> = Net Issuance<sub>t</sub> / Outstanding Stock<sub>t-1</sub>.

Sources: BIS Locational Banking Statistics by residence; BIS International Debt Securities Statistics.



# Summary Statistics

<i>Sector</i>	<i>Region</i>	Mean		Standard deviation	
		XBL	IDS	XBL	IDS
All	All	2.45	3.69	11.98	15.90
	AE	2.06	3.61	9.55	15.49
	EME	2.78	3.76	13.68	16.25
Banks	All	3.37	5.84	24.92	44.07
	AE	2.45	4.80	13.16	26.21
	EME	4.14	6.76	31.57	55.31
Non-banks	All	2.78	4.02	13.26	29.47
	AE	2.30	3.78	10.80	19.09
	EME	3.19	4.22	15.01	36.12

## Disentangling the effects across AEs and EMEs

- **Loans:** similar results for AEs and EMEs;
- **IDS:** impact of VIX considerably larger for EMEs.

Explanatory variables	Dependent variable: $\Delta$ Cross-border loans		Dependent variable: $\Delta$ International debt securities	
	Advanced economies	Emerging economies	Advanced economies	Emerging economies
<i>Pre-break</i>				
Log(VIX)	-3.99***	-4.33***	1.02	-3.92***
$\Delta$ Fed funds rate	-2.19***	-4.67***	-2.56	-0.63
<i>Post-break (up to 2013:Q1)</i>				
Log(VIX)	-2.52*	-3.29**	-0.09	-3.05*
$\Delta$ Fed funds rate	-8.02***	-7.42***	-13.54***	-5.62***
<i>Post-break (up to 2015:Q4)</i>				
Log(VIX)	-1.15	-0.91	0.46	-2.69**
$\Delta$ Fed funds rate	-3.51***	-2.99***	-6.80***	-4.07***

# Empirical relevance for AE and EM borrowers, 25 basis point hike

	Cross-border loan growth rate (quarterly)		International debt securities growth rate (quarterly)	
	To banks	To non-banks	By banks	By non-banks
<b>AE borrowers</b>				
Pre-break $\Delta$	-0.56	-0.70	-0.11	-0.47
Post-break $\Delta$	-1.03	-0.85	-1.67	-1.66
(sample mean)	2.45	2.30	4.80	3.78
(sample std dev)	13.16	10.80	26.21	19.09
<b>EM borrowers</b>				
Pre-break $\Delta$	-1.26	-1.10	-0.95	-0.04
Post-break $\Delta$	-1.54	-0.10	-3.10	-0.93
(sample mean)	4.14	3.19	6.76	4.22
(sample std dev)	31.57	15.01	55.31	36.12

# Disentangling the effects in advanced and emerging market economies with different post-break periods using consolidated data

Explanatory variables	Dependent variable: $\Delta$ International claims	
	Advanced economies	Emerging economies
<i>Pre-break</i>		
Log(VIX)	-2.49***	-3.66***
$\Delta$ Fed funds rate	-0.11	-1.93***
<i>Post-break (up to 2013:Q1)</i>		
Log(VIX)	-3.69***	-2.25***
$\Delta$ Fed funds rate	-5.20***	-4.27***
<i>Post-break (up to 2015:Q4)</i>		
Log(VIX)	-3.02***	-1.55***
$\Delta$ Fed funds rate	-2.89***	-3.13***

Notes: The sample includes quarterly data on international claims (all) from lending banks in 30 countries to recipients in 64 countries over the period 2000:Q1 - 2015:Q4. The post-break period can have two different lengths: up to the Taper Tantrum (2009:Q1 - 2013:Q1) and up to the end of the sample (2009:Q1 - 2015:Q4). Robust standard errors in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. (1) Effective federal funds rate for the period 2001:Q1 - 2008:Q4, Wu-Xia Shadow rate for the period 2009:Q1 - 2015:Q4. The regressions include  $\Delta$ Real GDP,  $\Delta$ Sovereign Ratings, Chinn-Ito Index,  $\Delta$ Real Global GDP and a break dummy that takes value 1 after the break date (2009:Q1). The regressions also include a full set of borrowing country and lending country fixed effects.

# R squared decomposition- Locational baseline regressions (by borrowing country) with structural breaks

Region	Variables	Dependent variable: $\Delta$ Cross-border loans			Dependent variable: $\Delta$ International debt securities		
		All	to banks	to non-banks	All	by banks	by non-banks
AEs	<i>Pre-break</i>						
	Global	38.26	29.78	46.89	49.56	19.03	43.10
	Local	61.74	70.22	53.11	50.44	80.97	56.90
	<i>Post-break (up to 2015:Q4)</i>						
	Global	55.88	59.47	52.79	46.73	54.43	57.35
	Local	44.12	40.53	47.21	53.27	45.57	42.65
	<i>Total global</i>	40.99	34.56	48.10	48.01	31.81	52.93
	<i>Total local</i>	59.01	65.44	51.90	51.99	68.19	47.07
EMEs	<i>Pre-break</i>						
	Global	71.05	70.83	70.41	90.47	93.99	77.41
	Local	28.95	29.17	29.59	9.53	6.01	22.59
	<i>Post-break (up to 2015:Q4)</i>						
	Global	23.22	42.00	9.82	71.09	83.48	59.86
	Local	76.78	58.00	90.18	28.91	16.52	40.14
	<i>Total global</i>	52.48	58.58	50.57	78.00	87.45	66.69
	<i>Total local</i>	47.52	41.42	49.43	22.00	12.55	33.31

# R squared decomposition- Locational baseline regressions with structural breaks

Region	Variables	Dependent variable: $\Delta$ Cross-border loans			Dependent variable: $\Delta$ International debt securities		
		All	to banks	to non-banks	All	by banks	by non-banks
	<i>Pre-break</i>						
	Global	54.63	51.09	60.34	65.02	51.22	70.04
	Local	45.37	48.91	39.66	34.98	48.78	29.96
	<i>Post-break (up to 2015:Q4)</i>						
<b>All Countries</b>	Global	41.02	53.33	36.16	57.53	82.59	66.52
	Local	58.98	46.67	63.84	42.47	17.41	33.48
	<i>Total global</i>	51.35	51.75	56.06	60.09	68.87	67.19
	<i>Total local</i>	48.66	48.25	43.94	39.91	31.13	32.81

Notes: The table contains the percentages of the  $R^2$  explained by global and local variables for various types of cross-border flows. The  $R^2$  refers to a regression of one type of flow on both local and global variables. The percentages refer to the pre-break sample, the post-break sample and the overall sample. These regressions include a full set of country fixed effects. Global variables include the  $\log(VIX)$ ,  $\Delta$ Real Global GDP and  $\Delta$ FFR (i.e.  $\Delta$ Effective federal funds rate for the period 2001:Q1 – 2008:Q4,  $\Delta$ Wu-Xia Shadow rate for the period 2009:Q1 – 2015:Q4). Local variables include  $\Delta$ Real GDP,  $\Delta$ Sovereign Ratings, the Chinn and Ito (2006) measure of financial openness. The model includes a structural break in 2009:Q1. The sample includes quarterly data on cross-border flows (loans and debt securities) for 64 recipient countries over the period 2000:Q1 - 2015:Q4.