



BANK FOR INTERNATIONAL SETTLEMENTS

Global dollar credit: links to US monetary policy and leverage

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* Views expressed are those of the authors and not necessarily the views of the BIS

Federal Reserve ease transmitted by

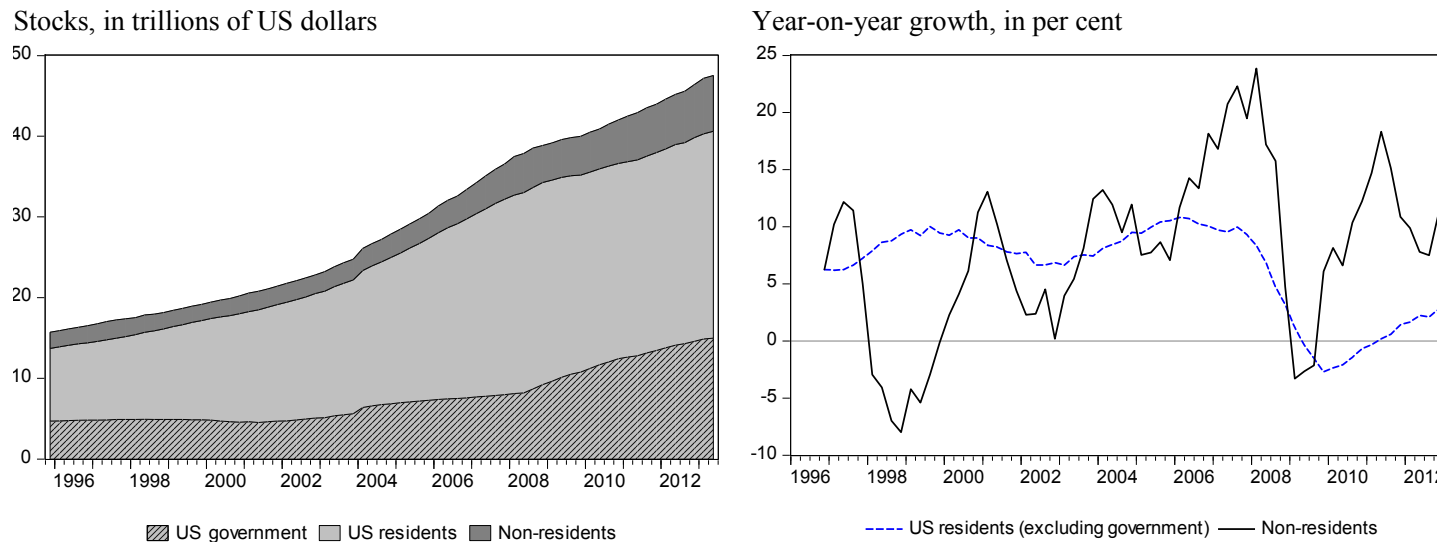
- Central banks set low policy rates.
- Global bond yields fall.
- Local currencies appreciate.
- Capital flows strongly.
- **Dollar credit cheaper and more available.**

Motivation

- When financing conditions ease, foreign currency and cross-border credit can serve as marginal financing sources in the lead-up to crises (CGFS, 2011; Avdjiev et al, 2012).
- Since 2009, banks and bond investors have extended a very substantial stock of US dollar credit to non-financial borrowers outside the US. This has relevance for the discussion of global liquidity and global monetary policy transmission.
- We contribute to this policy discussion by analysing the links between US monetary policy, including unconventional monetary policy, leverage, and investor risk appetite to dollar credit extended to non-US borrowers.

US dollar credit to non-financial firms, households and governments

Figure 1



Notes: Credit to non-financial residents in the United States from Federal Reserve flow of funds data, excluding identified credit to these borrowers in non-domestic currencies (ie cross-border and locally-extended loans and outstanding international bonds in currencies other than the US dollar). Dashed line plots credit to the government. US dollar credit to non-resident non-financial sector borrowers is the sum of outstanding dollar bonds issued by non-financial borrowers and cross-border and locally extended dollar loans to non-banks outside the United States.

Sources: Board of Governors of the Federal Reserve; IMF, *International Financial Statistics*; BIS international debt statistics and locational banking statistics by residence.

Preview of main findings

- Both US monetary policy stance and cost of leverage matter for growth in offshore US dollar credit, but the relative importance of these factors has changed over time.
- Prior to the crisis, banks extended dollar credit to non-US borrowers drawing on low funding rates and low-cost leverage.
- After 2008 however, and especially after the Federal Reserve began its large-scale bond purchases, the compression of long term rates shifted the transmission from banks to bond investors.

Brief review of previous work

- Most studies of dollarisation (or euroisation) concern economies with high rates (eg Brown & Stix, 2014), but most dollar credit in economies with single-digit rates.
- Bruno & Shin (2014) and others: association between bank leverage and short-term yields with international **bank** lending.
- Turner (2014) and Lo Duca et al (2014) analyse impact of unconventional monetary policy – large-scale bond buying– on bond issuance.
- These studies mix dollar prices and nondollar quantities.

Outline of presentation

- Description of offshore US dollar credit.
 - Bank loans vs bonds.
 - Residence of borrower.
 - Declining importance of bank holdings of bonds.
 - Role of US banking system and US bond investors.
- Analysis of drivers of offshore US dollar credit.
 - Bank loans.
 - Bonds.
 - US monetary policy, leverage (and controls).

US dollar credit to non-banks outside the United States

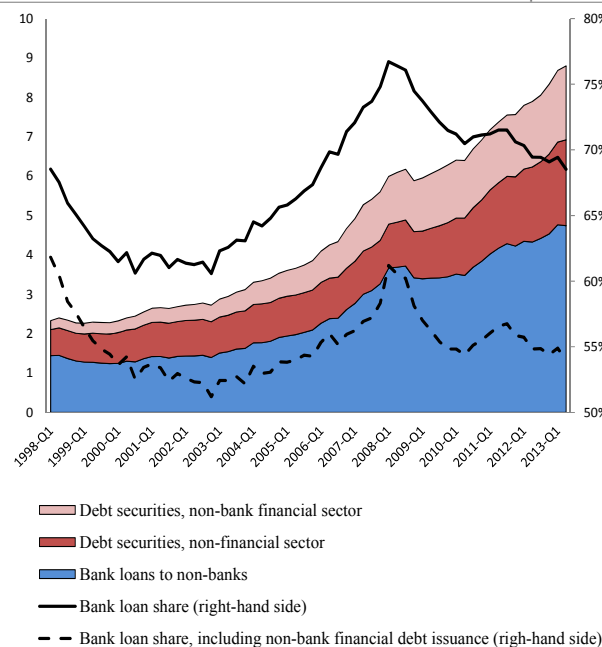
Broken down by instrument

Figure 2A

Outstanding stocks

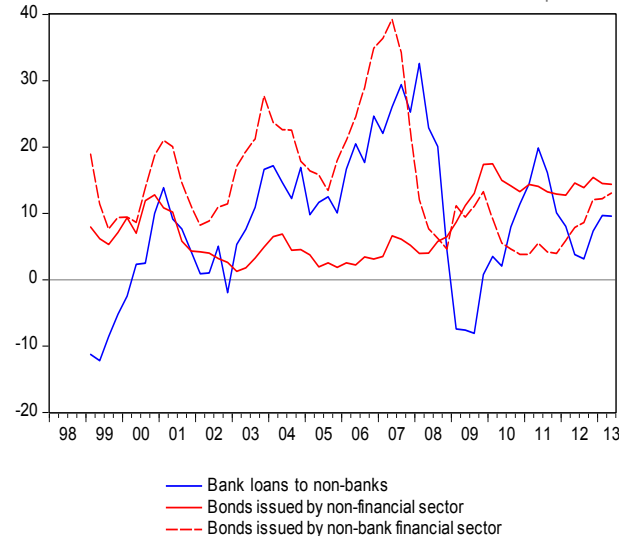
In trillions of US dollars

In per cent



Year-on-year growth rate

In per cent



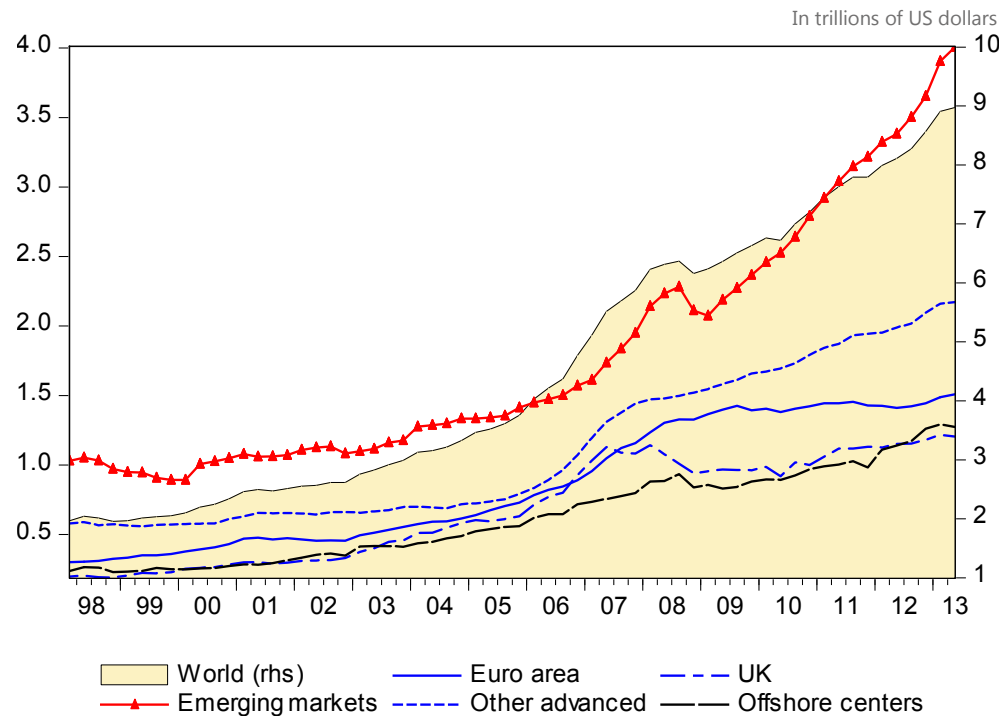
Notes: Bank loans include cross-border and locally extended loans to non-banks outside the United States. For China and Hong Kong SAR, locally extended loans are derived from national data on total local lending in foreign currencies on the assumption that 80% are denominated in US dollars. For other non-BIS reporting countries, local US dollar loans to non-banks are proxied by all BIS reporting banks' gross cross-border US dollar loans to banks in the country. Bonds issued by US national non-bank financial sector entities resident in Cayman Islands have been excluded.

Sources: IMF, *International Financial Statistics*; Datastream; BIS international debt statistics and locational banking statistics by residence; authors' calculations.

US dollar credit to non-banks outside the United States

Broken down by counterparty country

Figure 2B

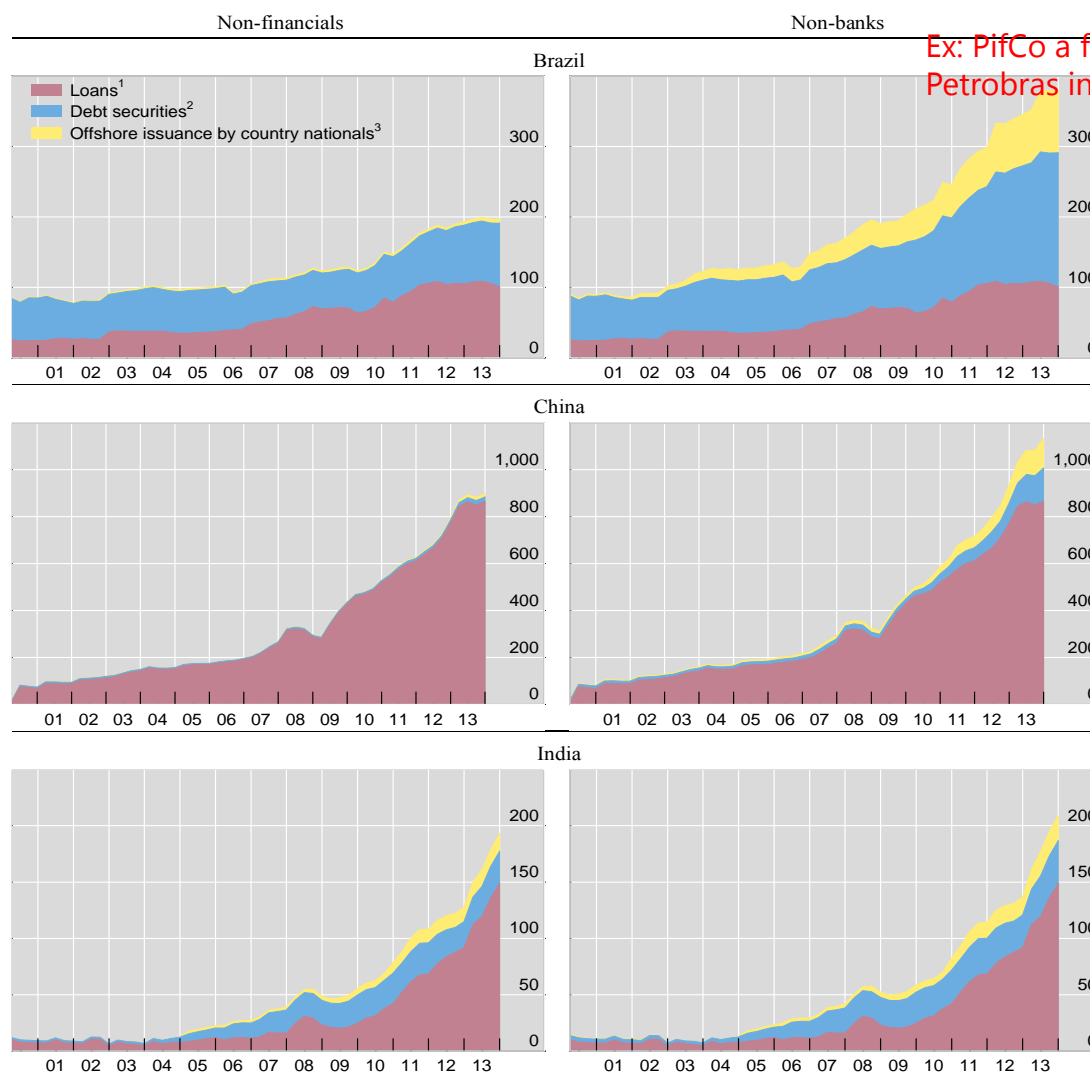


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Sources: IMF, *International Financial Statistics*; Datastream; BIS international debt statistics and locational banking statistics by residence; authors' calculations.

US dollar-denominated credit to Brazil, China and India, in billions of dollars

Figure 3



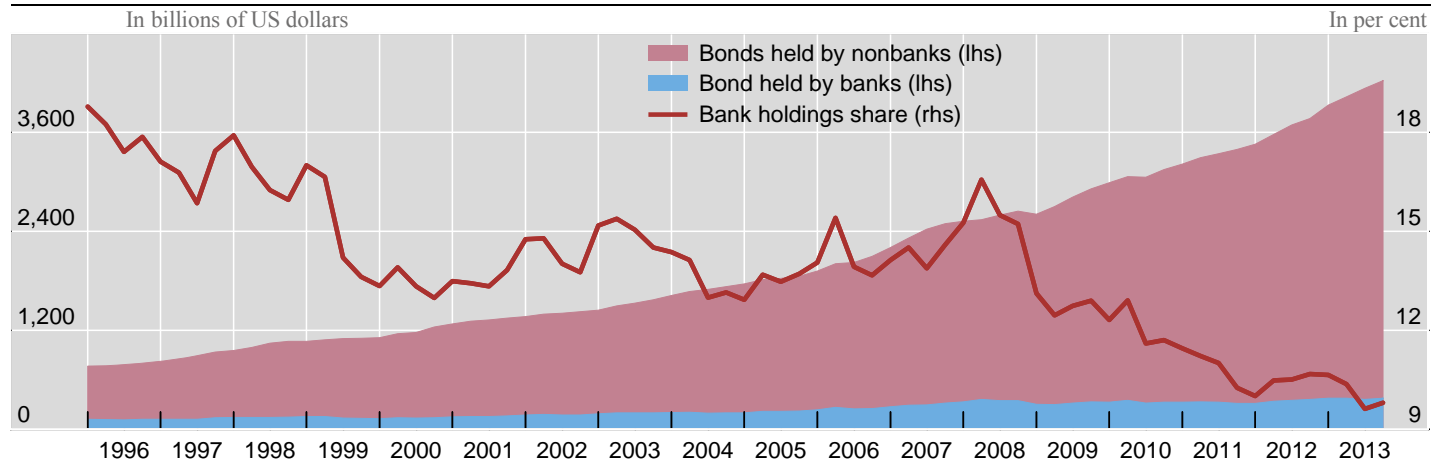
Ex: PifCo a finance subsidiary of Petrobras in the Cayman Islands

¹ US dollar denominated loans to residents of the country listed in the panel titles. For China, locally extended US dollar loan are estimated from national data on total foreign currency loans assuming 80% are dollar denominated. ² Outstanding US dollar debt securities issued by residents of the country listed in the panel title. ³ Outstanding US dollar denominated bonds issued offshore (ie outside the country listed in the panel title) by entities with nationality listed in the panel title.

Source: BIS locational banking statistics by residency; BIS International Debt Securities Statistics; national sources

Banks' holdings of dollar bonds issued by non-banks, residents outside the United States

Figure 4



Note: Excludes bonds issued by residents of Cayman Islands.

Sources: BIS locational banking statistics by residency; BIS international debt securities statistics; authors' calculations.

Offshore \$ credit to non-banks and US funding

- Bank loans have little to do with the US
 - \$0.9 of \$4.4 trillion loans to non-residents booked in US
 - More than 80% of offshore \$ bank loans do not come from US banks
 - Since 2011, not funded by interbank outflows from the United States. See McCauley and McGuire (2014).
- Bond market credit largely supplied by US residents
 - Share of US investors in dollar bonds issued by non-US residents is \$1.4 of \$4.1 trillion (eg 1/3).
- How can this be?
 - Non-US banks operating outside the United States have trillions of dollars of deposits and can swap into dollars, too.
 - Also, asset managers located outside the United States have large dollar assets under management.

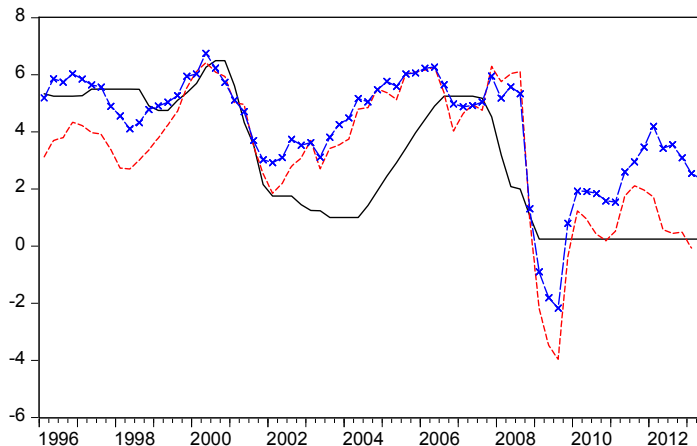
Table 1: Determinants of US dollar credit growth at the global level

Factor	Concept	Market metrics	Monetary policy
1	Short-term rates/ borrowing costs	Effective fed fund rate, LIBOR	Fed funds Taylor rule deviations (conventional)
2	Long-term rates/ yield on investment	10-year government bond yields	Term-premium compression (unconventional)
3	Equity market volatility, leverage of financial intermediaries	VIX, Financial CP, primary dealer repo	
4	Bond market volatility, risk appetite of bond investors	MOVE, Fixed income mutual fund flows	
5	Global controls, based on aggregates (for quantities) and GDP weighted averages (for interest rates) of major advanced economies and emerging markets	World trade, US dollar index, bank credit outside US, non-bank credit outside US, 10-year government bond yields	Policy rates

Short-term and long-term financing conditions in US dollars

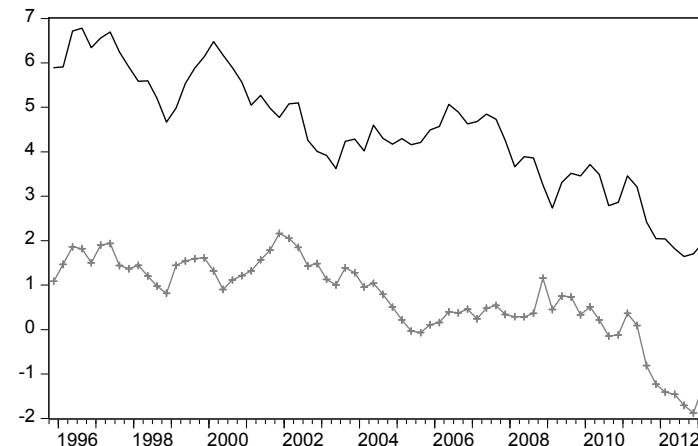
Figure 5

Fed funds, Libor, and Taylor-rule implied target rate



— Fed funds target
 - - - Taylor rule rate, simple PCE based
 - * - Taylor rule rate, mean rule rate based on Hoffman and Bogdanova (2012)

Yield on 10-year Treasury bond and its term premium



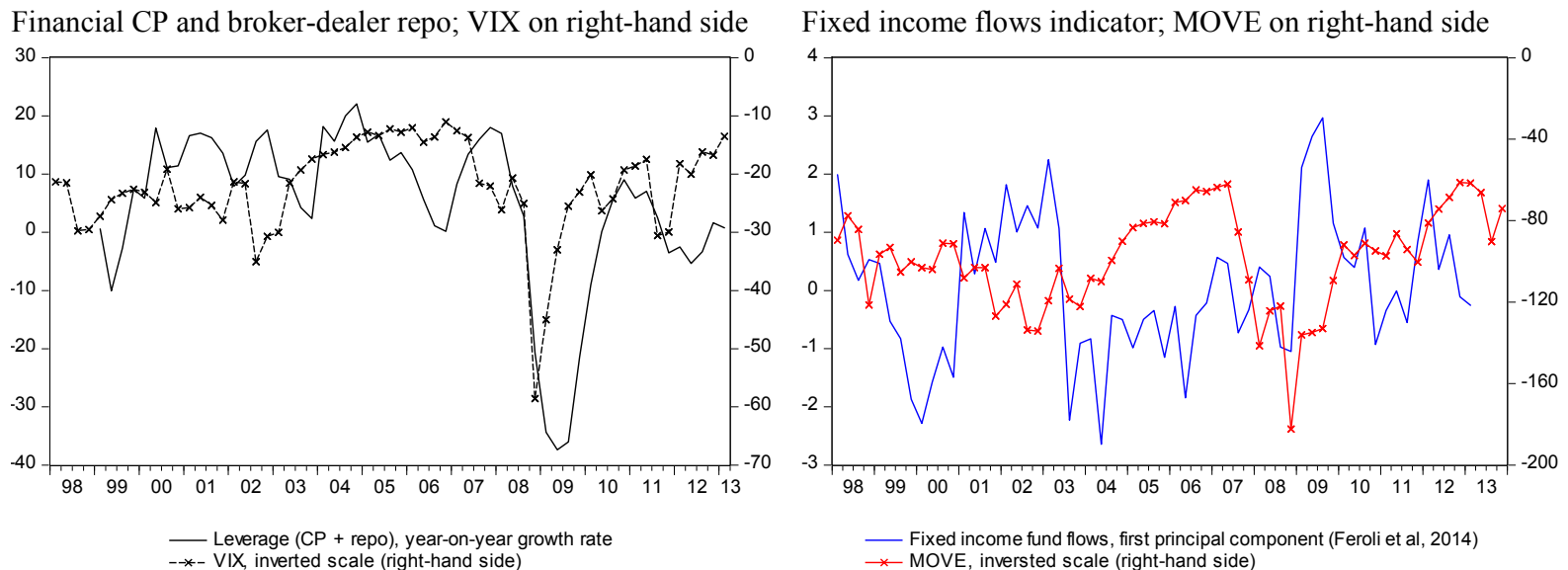
— 10-year US government bond yield — * — 10-year term premium

Notes: The plotted Taylor rule specification is taken from Hofmann and Bogdanova (2012) as the mean of Taylor rule rates for different combinations of varying inflation and output gap measures for $i=r^*+\pi+1.5(\pi-\pi^*)+0.5y$. An alternative simple Taylor rule takes the form $i=r^*+\pi+0.5(\pi-\pi^*)+0.5y$, where π is the inflation rate of the personal consumption expenditure (PCE) index and y denotes the output gap from the Hodrick-Prescott (HP) filtered trend. r^* and π^* , each set to 2%, represent the equilibrium real interest rate and the assumed target for the inflation rate. The ten-year real term premium is estimated using term structure models as the deviation in nominal yield from the sum of expected growth rate, expected inflation, and inflation risk premium.

Sources: Bloomberg; Consensus Economics; Haver Analytics; Hofmann and Bogdanova (2012); authors' calculations.

Quantity and price indicators of financial intermediary leverage

Figure 6



Notes: VIX is the Chicago Board of Exchange S&P500 index option implied volatility; in unit of annualized volatility, per cent. MOVE is the Merrill Option Volatility Expectations Index of Treasury bond yields. Fixed income flow indicators is the Feroli et al (2014) indicator of bond market sentiment based on first principal component of emerging markets, high-yield, investment grade, and MBS bond fund flows.

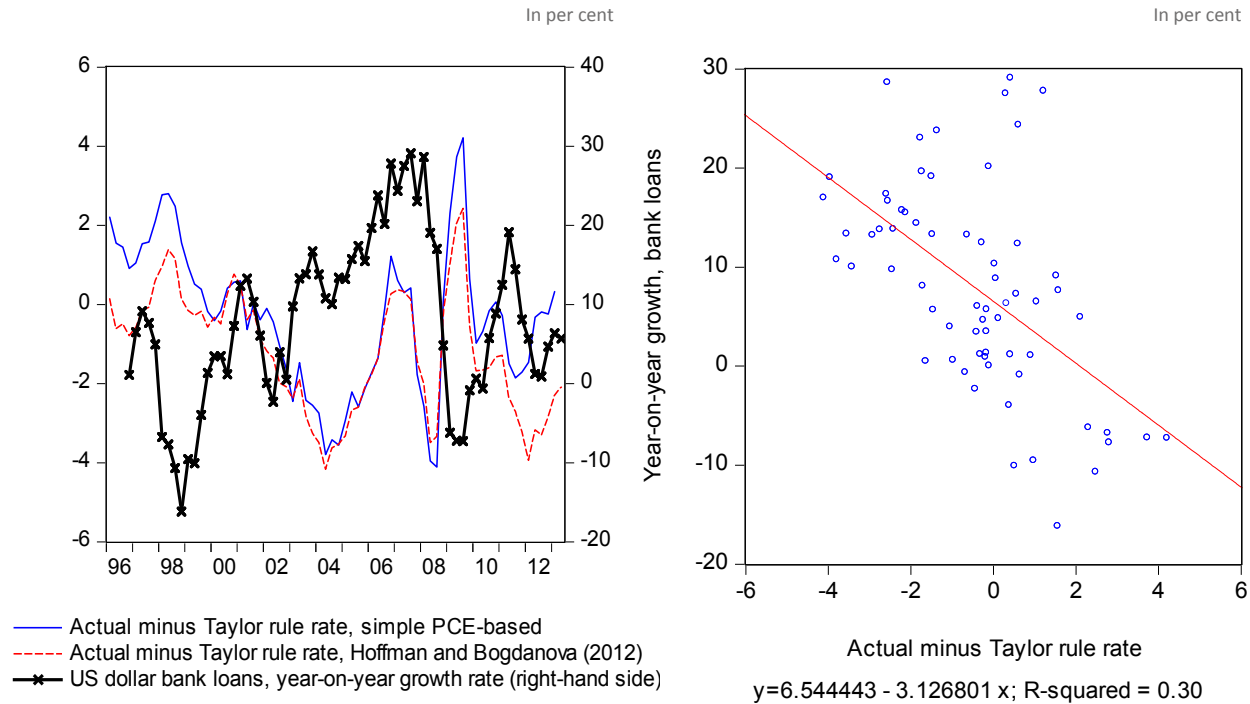
Sources: Bloomberg; Federal Reserve Bank of New York; Feroli et al (2014); authors' calculations.

Deviations of fed funds rate from Taylor rules and growth in offshore dollar bank loans

Figure 7

Fed funds rate deviations from Taylor rules and US dollar bank lending to non-residents

Scatter plot against the simple, PCE-based Taylor rule



Notes: Left-hand panel used the Taylor rule specification taken from Hofmann and Bogdanova (2012) as the mean of Taylor rates for different combinations of varying inflation and output gap measures for $i = r^* + \pi + 1.5(\pi - \pi^*) + 0.5y$. Right-hand panel uses the Taylor rule using output gap and PCE inflation: $i = r^* + p + 0.5(p - p^*) + 0.5(y - y^*)$.

Source: Bloomberg, Consensus Economics; BIS locational banking statistics by residence; Hofmann and Bogdanova (2012); authors' calculations.

Bank credit regression:

$$d\log CRED_t^{Bank} = \alpha + \beta_R^B dSTRATES_{t-1} + \beta_V^B VOLA/LEVERAGE_{t-1} + \beta_T^B \mathbf{X}_t + \gamma d\log CRED_{t-1}^{Bank} + \epsilon_t, \quad (1)$$

Bond market credit regression:

$$d\log CRED_t^{Debt} = \alpha + \beta_T^D dTERMPREM_{t-1} + \beta_V^D VOLA/LEVERAGE_{t-1} + \beta_T^D \mathbf{X}_t + \gamma d\log CRED_{t-1}^{Debt} + \epsilon_t, \quad (2)$$

Table 2: Regression analysis of growth in offshore US dollar bank lending

	(1)	(2)	(3)	(4)
Dependent variable: offshore US dollar bank lending to non-banks				
Fed funds deviation from Taylor rule ^a	0.575 (0.458)	0.670 (0.493)	0.462 (0.381)	0.719* (0.419)
VIX ^b	-0.167** (0.068)	-0.160** (0.075)		
Leverage (fin. CP + primary dealer repo) ^c			0.200** (0.098)	0.128 (0.112)
Bank credit outside of US ^d	0.364 (0.545)	0.323 (0.527)	1.061* (0.535)	0.902 (0.549)
US dollar index	-0.278* (0.155)	-0.236 (0.201)	-0.197 (0.167)	-0.064 (0.176)
World trade volume		0.044 (0.098)		0.150* (0.089)
Lag dependent variable	0.025 (0.104)	0.028 (0.104)	0.095 (0.130)	0.128 (0.127)
Constant	4.718*** (1.773)	4.549** (1.953)	-0.185 (0.788)	-0.190 (0.813)
Observations	69	69	60	60
R-squared	0.169	0.172	0.176	0.202

Notes: All the variables enter in first-differences or in log-differences, expressed in per cent; the dependent variable persistency is controlled for via the lag term.

^a Fed funds target rate and rate implied by the Taylor rule using output gap and PCE inflation: $i = r^* + p + 0.5(p - p^*) + 0.5(y - y^*)$; in first differences, per cent.

^b Chicago Board of Exchange S&P500 index option implied volatility; in unit of annualized volatility, per cent.

^c Per cent changes of amounts outstanding.

^d Sum of bank credit to private non-financial sector for 39 countries (excluding US), figures in local currency units have been converted into US dollars at constant 2013Q3 exchange rates prior to aggregation.

^e US dollar loans by BIS reporting banks to non-resident non-financial sector; in per cent changes of stock.

Sources: Bloomberg, Consensus Economics; BIS international debt statistics; BIS locational banking statistics by residence; DBSONline; Federal Reserve Bank of New York; Hoffman and Bogdanova (2012); authors' calculations.

Table 3: Regression analysis of the growth in offshore US dollar denominated bonds

	(1)	(2)	(3)	(4)
Dependent variable: offshore US dollar non-bank financial debt ^e				
Term premium, 10-year Treasuries ^a	-0.164 (0.680)	-0.059 (0.522)	-0.301 (0.593)	-0.330 (0.464)
MOVE ^b	0.002 (0.008)	-0.003 (0.007)		
Fixed income flows indicator ^c			0.311* (0.174)	0.128 (0.174)
Non-bank credit outside of US ^d	0.021 (0.155)	-0.017 (0.146)	0.125 (0.146)	0.090 (0.137)
US dollar index	0.124 (0.089)	0.002 (0.100)	0.106 (0.082)	-0.030 (0.089)
World trade volume		-0.092** (0.039)		-0.087*** (0.032)
Lag dependent variable	0.383*** (0.109)	0.387*** (0.107)	0.444*** (0.114)	0.483*** (0.112)
Constant	1.390 (0.951)	2.071** (0.918)	1.210*** (0.354)	1.274*** (0.342)
Observations	69	69	60	60
R-squared	0.186	0.249	0.332	0.385

Notes: All the variables enter in first-differences or in log-differences, expressed in per cent; the dependent variable persistency is controlled for via the lag term.

^a The ten-year real term premium is estimated using term structure models as the deviation in nominal yield from the sum of expected growth rate, expected inflation, and inflation risk premium.

^b Merrill Option Volatility Expectations Index of Treasury bond yields.

^c Feroli et al (2014) indicator of bond market sentiment based on first principal component of emerging markets, high-yield, investment grade, and MBS bond fund flows.

^d Sum of non-bank credit to private non-financial sector for 39 countries (excluding US), figures in local currency units have been converted into US dollars at current exchange rates prior to aggregation.

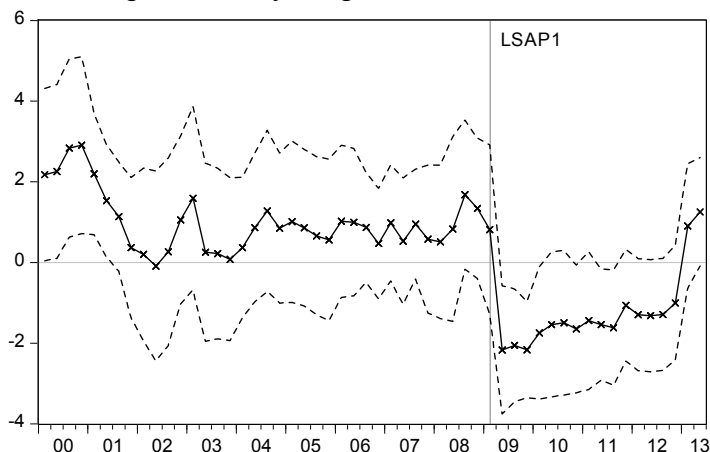
^e US dollar denominated international debt securities outstanding issued by non-resident, private non-financial borrowers; in per cent changes of stock outstanding.

Sources: Bloomberg, Consensus Economics; BIS international debt statistics; BIS locational banking statistics by residence; DBSONline; Federal Reserve Bank of New York; authors' calculations.

Offshore US dollar bonds and term premium compression on 10-year Treasury bonds

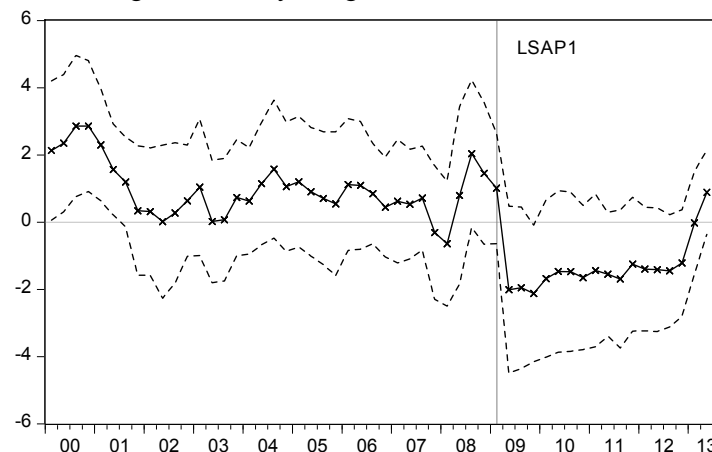
Figure 8

Controlling for volatility using VIX



—x— Coefficient, Term premium on 10-year Treasuries
 --- 90% confidence interval

Controlling for volatility using MOVE



—x— Coefficient, term premium on 10-year Treasuries
 --- 90% confidence interval

Estimates based on 16-quarter rolling regressions. All the variables enter in first-differences or in log-differences, expressed in per cent; the dependent variable persistency is controlled for via the lag term. The ten-year real term premium is estimated using term structure models as the deviation in nominal yield from the sum of expected growth rate, expected inflation, and inflation risk premium.

Sources: Bloomberg; Consensus Economics; BIS international debt statistics; BIS locational banking statistics by residence; authors' calculations.

Table A4: Growth in offshore US dollar denominated international debt of non-financial sector and lagged drivers, specification with 10-year yield gap

	(1)	(2)	(3)	(4)
Dependent variable: offshore US dollar non-bank financial debt				
10-year yield gap ^a	0.898** (0.444)	0.913* (0.487)	0.607 (0.410)	0.637 (0.403)
MOVE ^b	0.001 (0.008)	-0.004 (0.007)		
Fixed income flows indicator			0.281 (0.190)	0.094 (0.177)
Non-bank credit outside of US ^c	-0.025 (0.145)	-0.063 (0.137)	0.095 (0.131)	0.059 (0.122)
US dollar index	0.160* (0.092)	0.040 (0.104)	0.120 (0.078)	-0.018 (0.086)
World trade volume		-0.093** (0.038)		-0.088** (0.035)
Lag dependent variable	0.409*** (0.104)	0.414*** (0.105)	0.463*** (0.108)	0.504*** (0.106)
Constant	1.492 (0.906)	2.168** (0.918)	1.234*** (0.358)	1.302*** (0.341)
Observations	69	69	60	60
R-squared	0.241	0.307	0.353	0.409

Notes:

All the variables enter in first-differences or in log-differences, expressed in per cent; the dependent variable persistency is controlled for via the lag term.

^a The 10-year yield gap is calculated as average 10-year yields (outside US) minus the yield on 10-year US Treasury bonds; yield outside US calculated as 2013:Q3 GDP-weighted average of Brazil, China, Euro area, India, Japan, Russia, and United Kingdom

^b Merrill Option Volatility Expectations Index of Treasury bond yields.

^c Feroli et al (2014) indicator of bond market sentiment based on first principal component of emerging markets, high-yield, investment grade, and MBS bond fund flows.

^d Sum of nominal GDP for 39 countries (excluding US), figures in local currency units have been converted into US dollars at constant 2012Q3 exchange rates prior to aggregation.

^e US dollar denominated international debt securities outstanding issued by non-resident, private non-financial borrowers; in per cent changes of stock outstanding.

Sources: Bloomberg, Consensus Economics; BIS international debt statistics; BIS locational banking statistics by residence; DBSONline; Federal Reserve Bank of New York; authors' calculations.

Time varying results: VAR approach

- Consider the time-varying parameter Bayesian VAR (TVP-VAR) model with stochastic volatility (Primiceri, 2005 and Nakajima, 2011):
- $\mathbf{y}_t = \mathbf{y}_{t-1}\boldsymbol{\beta}_t + \mathbf{A}_t^{-1}\boldsymbol{\Sigma}_t\boldsymbol{\varepsilon}_t, t = s + 1, \dots, n$ (A.1)
- where the coefficients β_t and the parameters A_t and $\boldsymbol{\Sigma}_t$ are all time-varying and
- $\mathbf{y}'_t = (dTERMPREM_t, MOVE_t, USDDEBT_t)$, with
- We estimate the three-variable TVP-VAR model using quarterly data from Q1 1996 to Q3 2013

Time varying results: VAR approach (cont'd)

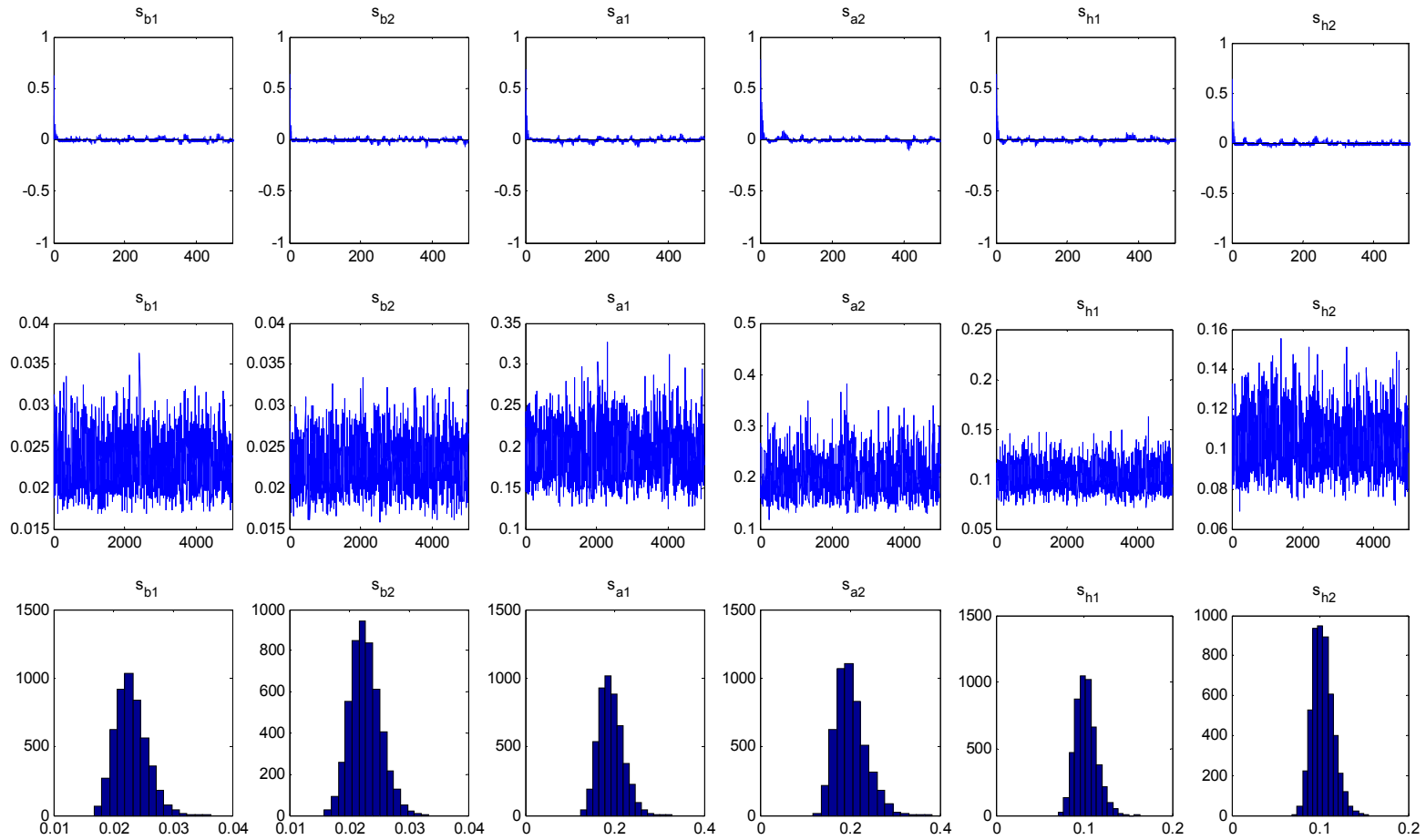
$$\mathbf{y}_t = \mathbf{y}_{t-1}\boldsymbol{\beta}_t + A_t^{-1}\boldsymbol{\Sigma}_t\boldsymbol{\varepsilon}_t, \quad t = s + 1, \dots, n, \quad (2)$$

$\mathbf{a}_t = (a_{21}, a_{31}, a_{32}, a_{41}, \dots, a_{k,k-1})'$ are stacked vector of the lower-triangular elements in A_t and $\mathbf{h}_t = (h_{1t}, \dots, h_{kt})'$ with $h_{jt} = \log \sigma_{jt}^2$ capturing the variance of ε_{jt} , for $j = 1, \dots, k$, $t = s + 1, \dots, n$.

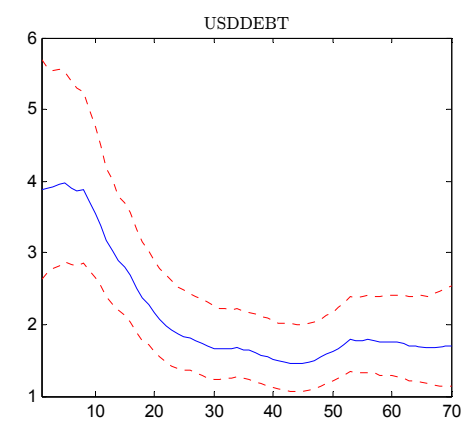
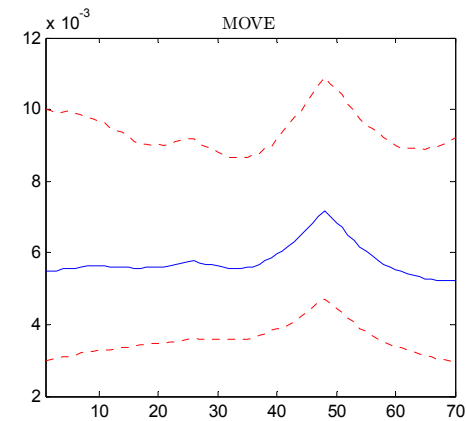
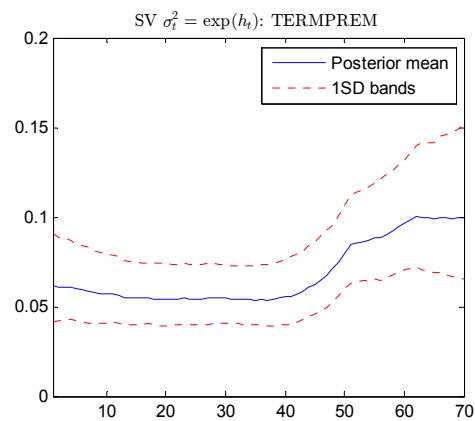
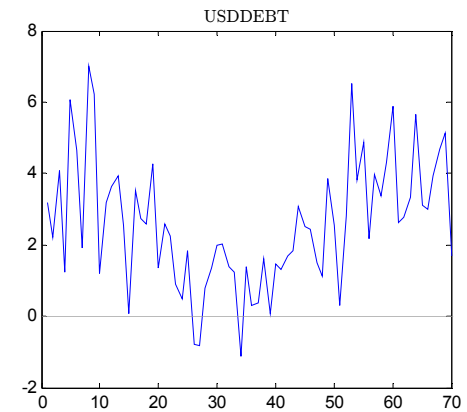
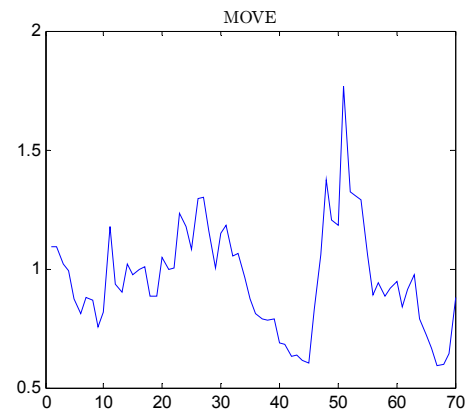
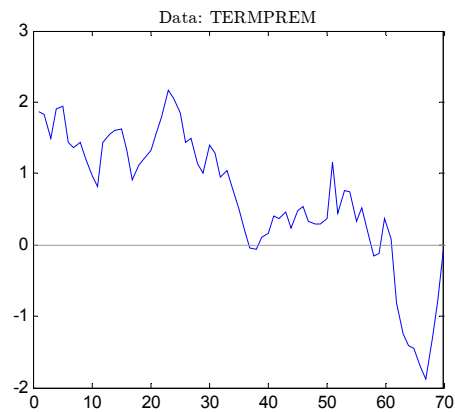
$$\begin{aligned} \boldsymbol{\beta}_{t+1} &= \boldsymbol{\beta}_t + u_{\beta t}, \\ \mathbf{a}_{t+1} &= \mathbf{a}_t + u_{at}, \\ \mathbf{h}_{t+1} &= \mathbf{h}_t + u_{ht}, \end{aligned} \quad \begin{pmatrix} \boldsymbol{\varepsilon}_t \\ u_{\beta t} \\ u_{at} \\ u_{ht} \end{pmatrix} \sim N \left(0, \begin{pmatrix} I & O & O & O \\ O & \boldsymbol{\Sigma}_\beta & O & O \\ O & O & \boldsymbol{\Sigma}_a & O \\ O & O & O & \boldsymbol{\Sigma}_h \end{pmatrix} \right),$$

for $t = s + 1, \dots, n$, where $\boldsymbol{\beta}_{s+1} \sim N(\mu_{\beta_0}, \boldsymbol{\Sigma}_{\beta_0})$, $\mathbf{a}_{s+1} \sim N(\mu_{a_0}, \boldsymbol{\Sigma}_{a_0})$ and $\mathbf{h}_{s+1} \sim N(\mu_{h_0}, \boldsymbol{\Sigma}_{h_0})$.

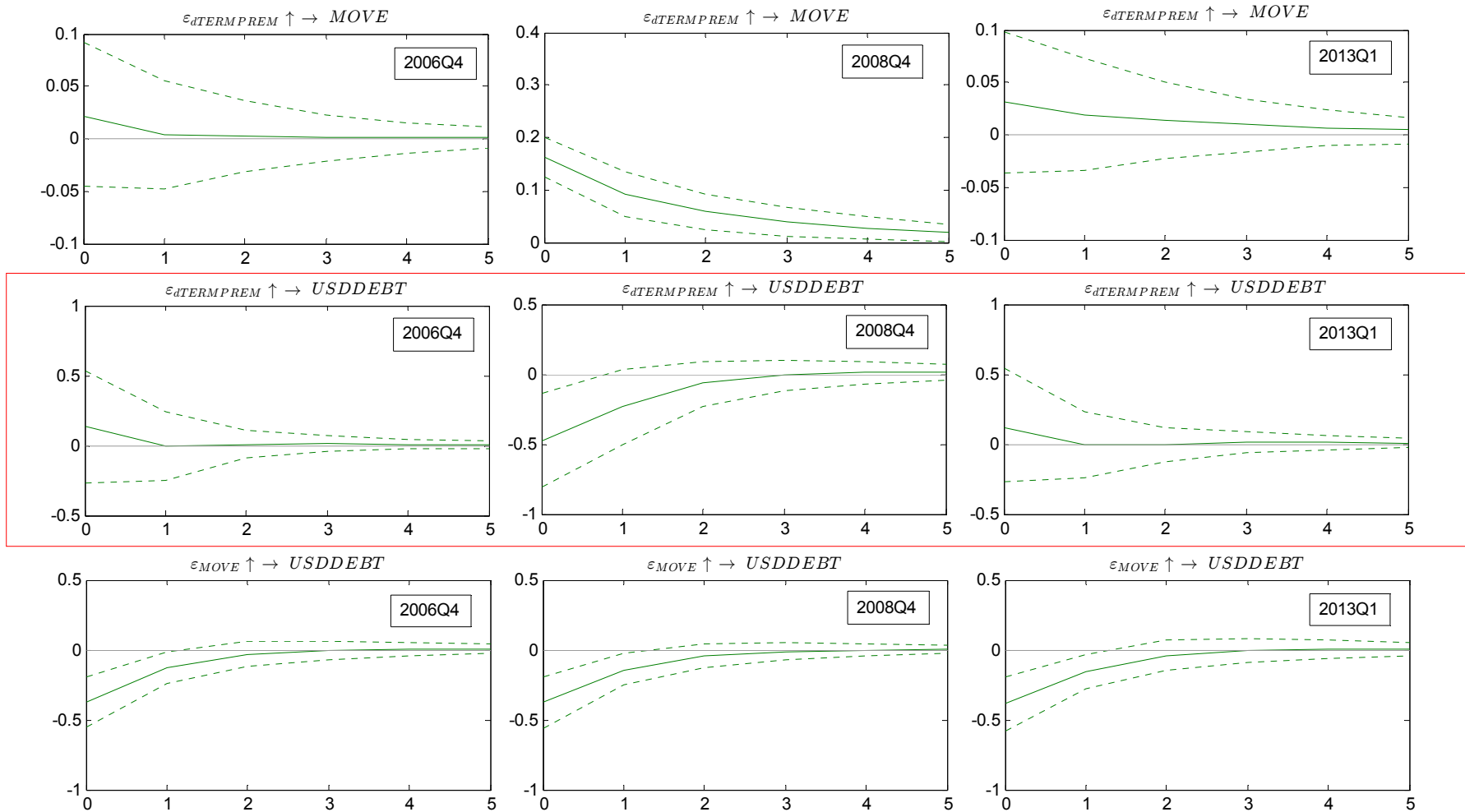
Selected parameter diagnostics:



Endogenous variables and the volatility of structural shocks:



Select time-varying impulse responses:



Conclusions: prior to the crisis

- The familiar drivers of bank credit also played predominant role in offshore US dollar credit growth. Bank leverage (as measured by financial CP), or low-cost leverage (as measured by the VIX) set the pace for offshore dollar lending.
- Assessment of the direct effect of short-term rates depends on the empirical set-up. Overall, most metrics support the prior that lower policy rates in the US have been associated with higher US dollar bank lending offshore.

Conclusions: since the crisis

- US dollar credit has grown fastest in the economies with relatively high domestic interest rates: EMEs and advanced economies not hit by the crisis.
- Non-bank investors provided an unusual share of dollar credit to non-US residents; intermediated through international bond markets, while banks have stepped back.
- The surge in US dollar borrowing through bond markets is associated with the compression of term premia via the Federal Reserve's bond buying.
- Policy questions proper to second stage of global liquidity: asset manager pro-cyclicality, carry trades, rollover risks.

Financial stability implications:

- Policy induced compression of term premia **directly affects the price of US dollar borrowing in offshore debt markets** (on top of spillover effects on yields of bonds denominated in other currencies, Neely (2010), Bauer and Neely (2012)).
- The ability of multinational firms to borrow dollars outside of home jurisdiction or to use offshore SPVs **limits the effectiveness of capital controls or higher interest rates imposed by home authorities.**
- While bond market funds are less subject to sudden reversals, the risks include **rollover risks, flighty corporate deposits** with domestic banks, fund various forms of **carry trades**, and by en large are **not captured in BOP or national debt statistics**, but could weigh on national FX reserves in time of stress.