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THE SHIFTING DRIVERS OF GLOBAL LIQUIDITY

Stefan Avdjiev
Leonardo Gambacorta
Linda S. Goldberg
Stefano Schiaffi

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ABSTRACT

The post-crisis period has seen a considerable shift in the composition and drivers of international bank lending and international bond issuance, the two main components of global liquidity. The sensitivity of both types of flow to US monetary policy rose substantially in the immediate aftermath of the Global Financial Crisis, peaked around the time of the 2013 Fed "taper tantrum", and then partially reverted towards pre-crisis levels. Conversely, the responsiveness of international bank lending to global risk conditions declined considerably post-crisis and became similar to that of international debt securities. The increased sensitivity of international bank flows to US monetary policy has been driven mainly by post-crisis changes in the behaviour of national lending banking systems, especially those that ex ante had less well capitalized banks. By contrast, the post-crisis fall in the sensitivity of international bank lending to global risk was mainly due to a compositional effect, driven by increases in the lending market shares of better-capitalized national banking systems. The post-2013 reversal in the sensitivities to US monetary policy partially reflects the expected divergence of the monetary policy of the US and other advanced economies, highlighting the sensitivity of capital flows to the degree of commonality of cycles and the stance of policy. Moreover, global liquidity fluctuations have largely been driven by policy initiatives in creditor countries. Policies and prudential instruments that reinforced lending banks' capitalization and stable funding levels reduced the volatility of international lending flows.

Stefan Avdjiev
Bank for International Settlements
Centralbahnplatz 2
Basel 4002, Switzerland
stefan.avdjiev@bis.org

Leonardo Gambacorta
Bank for International Settlements
Centralbanplatz, 2 4002 Basel
Switzerland
leonardo.gambacorta@bis.org

Linda S. Goldberg
Federal Reserve Bank-New York
33 Liberty Street
New York, NY 10045
and NBER
linda.goldberg@ny.frb.org

Stefano Schiaffi
Via Roberto Sarfatti, 25,
20100 Milan, Italy
stefano.schiaffi@phd.unibocconi.it

1. Introduction

International capital flows channel financial resources across borders to both public and private sector borrowers. Their two largest debt components, cross-border bank loans and international bond issuance, are the main elements of global liquidity (Bank for International Settlements, 2011a and 2011b). As such, they are important determinants of global financial conditions and worldwide economic activity. The existing empirical literature has established that global (push) and local (pull) factors are both important drivers of cross-border bank loans and international bond issuance. Among pull factors, the literature has identified recipient country output growth, sovereign credit risk, and the degree of capital account openness. The most important global drivers identified by the literature have been advanced economy monetary policies, global risk aversion and global output growth (e.g. Forbes and Warnock, 2012a; Miranda-Agrippino and Rey, 2015; and Cerutti, Claessens and Ratnovski, 2017).

While studies generally focus on identifying the drivers, they seldom examine the how and why of evolving sensitivities to global factors. Yet, the structure and volatility of cross-border bank loan and international bond flows clearly have changed considerably in the aftermath of the Global Financial Crisis (GFC). In the immediate aftermath of the crisis, cross-border loans contracted sharply. This was followed by a feeble recovery and a second sharp contraction during the peak of the euro area crisis. By contrast, international bond issuance was relatively robust during the post-crisis period. As a consequence, the composition of global liquidity has shifted away from cross-border bank loans and towards international bonds in what has been dubbed "the second wave of global liquidity" (Shin, 2013). Meanwhile, events such as the "taper tantrum" in 2013, when the Federal Reserve signalled it would start tapering its bond buying program, were marked by especially sharp changes in some capital flows to emerging markets (Khatiwada, 2017). Graph 1 contains a summary of the behaviour of the various types of flow at the global level for bank and nonbank borrowers. An extensive literature (reviewed in the next section) discusses the vulnerability of borrowing countries to international surges and retrenchments, and the potential policy tools available for containing excessive changes.

In this paper, we start with the conjecture that both the compositional changes in the landscape of international financial flows and the more novel advanced economy monetary and regulatory instruments have the potential to fundamentally alter global liquidity and its drivers. We specifically investigate the changes in sensitivities of the main components of global liquidity to global drivers during the post-crisis period. We drill down into observed changes, test for their proximate reasons, and distinguish between persistent versus transitory drivers. To achieve these ends, we draw on multiple databases on global liquidity component flows from both borrower country and creditor country perspectives, distinguishing between instrument types (international debt securities versus international bank loans), and between borrowing sectors (bank versus non-bank). Using the BIS International Debt Securities (IDS) Statistics and the BIS Locational Banking Statistics (LBS), we create a quarterly panel of international bank loan and bond flows to 64 recipient countries for the period between 2000:Q1 and 2015:Q4. In addition, we utilise the BIS Consolidated Banking Statistics (CBS) in order to assign loans to specific national lending banking systems. Using Bankscope, we obtain information on lending banking system balance sheet characteristics. We also incorporate a range of other data on prudential instrument and monetary policy developments, from the perspective of both the borrowers and the creditor countries. Advanced economy monetary

policies, as well as shadow measures that capture unconventional policies, are also incorporated into the analysis.

After replicating the types of global factor and local factor results documented in prior studies, our analytical contributions centre around three main sets of results. Our first key result is that international capital flow sensitivities to global factors have changed considerably since the GFC. Advanced economy monetary policy, proxied by US monetary policy, became a more potent driver of both cross-border loan and international bond flows. The estimated policy impacts peaked in 2013 and then partially retraced toward pre-crisis levels while remaining elevated. Meanwhile, the sensitivity of cross-border bank loan flows to global risk conditions declined considerably post-crisis and became similar to the respective risk sensitivity observed for international bond flows. In fact, international bank loan and bond flows became more similar in terms of their responsiveness to global factors after the GFC. Overall, aggregate global liquidity flows (the sum of international bank loan and bond flows) have become more sensitive to US monetary policy and less sensitive to global risk.

The second set of results shows that post-crisis shifts in sensitivities of international bank loan and bond flows to global factors, observed from the borrower perspective, arise from a combination of changes in the country composition of lending banking systems and from changes in the behaviour of the creditors involved in international financial flows. Working across multiple databases, we show an increase in the responsiveness of flows from individual lending banking systems to US monetary policy. We also find evidence of a compositional shift toward national lending banking systems with lower sensitivity to global risk conditions.

We drill deeper into the type of variation observed to investigate the contributions of a range of prudential measures, bank business model features, and monetary regimes in the creditor countries. We find that the features of financial intermediaries that previously have been shown to stabilize domestic bank lending response to liquidity risk, like bank capital ratios and deposit funding, also support expansion of international market share relative to weaker peer country systems and help explain changing behaviours. National banking systems that were better capitalized before the GFC experienced smaller post-crisis rises in sensitivity to US monetary policy and larger increases in international lending shares. Higher ex-ante shares of deposits in total funding and of locally booked claims in total foreign claims were also associated with larger increases in international lending market shares. Tighter local reserve requirements pre-crisis were associated with relative expansions of international market shares in the post crisis period.

Even post-GFC there has been a significant evolution of creditor sensitivities to global risk and US monetary policy. Within the post-GFC period, we tie this evolution to the roles of banking sector performance metrics and relative monetary policy stances across advanced economies. High sensitivities to US monetary policy post-GFC are tied to the relative path of expected US monetary policy vis-à-vis that of other major advanced economies, proxied using two-year interest rate futures data. In particular, sensitivity in cross-border loans is enhanced in the years immediately following the crisis, consistent with an interpretation that US monetary policy served as a stronger indicator of global monetary policy in a period of low growth across advanced economies. This effect unwound as a perception took hold of greater policy divergence across advanced economies starting in 2013. Proxies for the business models of creditor banking systems played less of a role of in this evolution.

These results contribute importantly to both research and policy debates around global liquidity and local stabilization. One pertinent question is whether the enhanced diversification across financing types will have different consequences in the case of future stress episodes, as well as in normal periods. This is an especially pertinent issue if, ex-ante, bank loan and debt securities financing agents are subject to distinct degrees of leverage and balance sheet constraints. We show that pre-crisis borrowers experienced more global factor sensitivity in cross border loans than in international debt securities. As a consequence, international debt securities remained relatively robust during the global financial crisis. Post-crisis, the sensitivities of both types of financing have become more similar.

Another question is how stabilization challenges across countries borrowing internationally evolve in post-crisis periods and when the synchronization of business cycles across countries is enhanced. The range of evidence we provide across econometric exercises suggests that the large increases in sensitivities to US monetary policy post GFC may have been a transitory phenomenon, whereas the declines in global liquidity sensitivity to risk measures may be more persistent. At least in international bank flows, behavioural changes in the period immediately following the GFC were driven largely by the convergence in advanced economy monetary policies. These transitory effects gradually weakened when the monetary policies of advanced economies started to diverge in 2013. More persistent effects may come from the increased market shares of better-capitalized lending banking systems, whose international lending tends to be less responsive to fluctuations in global risk conditions. The implications would be that evolving global drivers also change the scope for monetary autonomy and prudential policies options for borrowing countries. Moreover, a potentially important consequence of the focus on capital and stable funding in creditor countries are reduced amplitudes of global liquidity surges and waves as observed by borrowers.

The remainder of the paper is organised into six sections. Section 2 reviews relevant findings of the existing literature on global liquidity and its drivers, also focusing on differences between banks and non-banks as creditors and debtors. Section 3 presents the econometric methodology that we employ in respective empirical investigations. Section 4 describes the data. Section 5 provides the empirical results and related discussion. Section 6 presents robustness tests. Section 7 concludes.

2. Previous literature

Global liquidity and drivers have been explored in a number of related studies. The most extensive previous literature is on international capital flows. The second strand of literature is more explicitly focused on global liquidity, international debt securities versus loans, and constraint differences across banks and non-banks. The third thread of literature addresses international monetary policy spillovers, covering the transmission channels through banks and capital markets, interest rate and asset price co-movements, and broader issues around the structure of the international monetary system and policy instrument availability.

The large literature on the drivers of capital flows focuses most extensively on emerging markets, and more recently considers advanced economies also as destinations of capital. Surges in cross-border flows to EMEs reflect improved macroeconomic fundamentals of the borrowing country (pull and local factors) and more favourable global conditions of a

primarily cyclical nature (push and global factors). Examples of such studies include those by Calvo et al. (1993), Ghosh and Ostry (1993), Fernandez-Arias (1996), Taylor and Sarno (1997), and Chuhan et al. (1998).[2]

The emphasis of the literature then shifted specifically to understanding gross (as opposed to net) international flows and distinguishing across different institutional participants. Portes and Rey (2005) show that information frictions and technology matter for the relative stability of gross flows. Broner et al. (2013) show the higher volatility in gross flows than in net flows, specifically in the context of business cycles and crises. Forbes and Warnock (2012b) present a systematic framework for analysing capital flows whereby extreme episodes are classified into four categories: surges, stops, flight and retrenchment. This work carefully documents how the most extreme capital flows episodes are driven by global factors, notably global risk aversion. Milesi-Ferretti and Tille (2011) document heterogeneity in the behaviour of various capital flows components during the Global Financial Crisis, emphasizing the dominant contraction of international banking flows and the relative stability of foreign direct investment. Post-crisis declines in bank-based cross-border lending, particularly by euro area banks, have been described in some analysis as financial deglobalization (Rose and Wieladek, 2011; Forbes et al. 2015) or "the great cross-border bank deleveraging" (Cerutti and Claessens, 2017; Bussière et al., 2016). The explanations provided include weaker economic activity; capital controls and the slower pace of liberalization; deleveraging, and risk aversion (CGFS 2011).

Related research uses micro-banking data to explore international financial linkages. Cetorelli and Goldberg (2012a), working with bank-specific data, show that contractions in international lending by global banks during the crisis were related to balance sheet shocks through holdings of asset-backed commercial paper. Contractions in some cases are shown to be magnified by policy interventions. Across UK banks, prudential policies and unconventional monetary policy in the form of a funding for lending scheme jointly contributed to a retrenchment of cross-border lending with differential effects across banks (Forbes, Reinhardt and Wieladek, 2017). More broadly, across countries prudential policy effects on international bank flows were associated with contractions in some cases and expansions elsewhere (Buch and Goldberg, 2017). The composition of lending banking systems, as some countries with banks that were well-capitalized pre-crisis expanded international activities post-crisis, as occurred for Canada among others (Damar and Mordel, 2017).

The actual channels of transmission that drive these co-movements have been identified by heterogeneity across bank-balance sheets. Cetorelli and Goldberg (2012b) show bank transmission through internal capital markets and heterogeneity in shock transmission to countries depending on their global bank-specific importance in lending and funding activity. Bruno and Shin (2015b) point to a direct role for balance sheet valuation by banks, as monetary policy spillovers drive cross-border bank capital flows and the US dollar exchange rate through the banking sector. Bruno and Shin (2015a) demonstrate that episodes of appreciation of the US dollar are associated with deleveraging of global banks and an overall tightening of global financial conditions. Banks also have been shown to have shifted their treatment of their sovereign exposures pre- versus post-crisis, later having more risk assigned

[2] See Koepke (2015) for a comprehensive summary of the literature in the drivers of capital flows to EMEs.

to these positions and posing different constraints (Acharya et al., 2013; Farhi and Tirole, 2016; De Grauwe and Ji, 2013). Banks have more pronounced bank lending channel responses to liquidity risk when they have low levels of capitalization and low deposit funding shares (Cornett et al. 2011; Buch and Goldberg, 2015).

A parallel and rapidly growing literature on the main drivers of global liquidity emphasizes specific global financial factors. Miranda-Agrippino and Rey (2015) argue that one global factor explains an important part of the variance of a large cross section of returns of risky assets and interpret this factor as time-varying market-wide risk aversion linked to US monetary policy. Similar main drivers are documented by Cerutti, Claessens and Ratnovski (2017) and include US monetary policy, global uncertainty (proxied by the VIX), the exchange rate value of the US dollar, and European bank conditions. Non-bank financial intermediations also have recently received attention.

Another type of shift occurred in the composition of international capital flows worldwide, as the first phase of global liquidity through banks was replaced to some degree by a second phase of global liquidity through corporate bond financing, particularly for emerging market borrowers (Shin, 2013).[3] Chung et al. (2016) link the evolution of global monetary aggregates to the financial activities of non-financial corporations (NFCs), with the non-core liabilities of NFCs reflecting global credit conditions and predicting global trade and growth. McCauley et al. (2015) find that unconventional monetary policy contributed to shifting the balance of dollar credit transmission from global banks to global bond investors, demonstrating a negative relationship between the term premium on 10-year Treasury bonds and international bond issuance during the post-crisis period.

Finally, the long literature on international monetary policy spillovers, with its focus on short-term interest rate co-movement and the constraints on stabilization policies posed by the international monetary trilemma, is directly relevant for analysis of global liquidity drivers. Shambaugh, Obstfeld and Taylor (2005) show that monetary policy rates across a large sample of countries can closely track advanced economy policy rates, particularly with the rates of countries playing a central role in the international monetary system. The form of exchange rate and monetary regimes in place influences the degree of co-movement, although greater near term autonomy can come from some restrictions on international capital movements (Klein and Shambaugh, 2008) and lower levels of banking globalization (Goldberg 2013). Prudential policy instruments are argued to potentially afford countries relief from international capital flow movements (Rey, 2013), although the evidence to date on consequences for flows through global banks is mixed and not yet large in magnitude.[4]

Collectively these papers show the importance for global liquidity and interest rate comovements of constraints on different types of institutions, the shifts in importance of these institutions, and the scope for policy responses to international financial flows. Our study takes an integrated approach by studying the flows through banks and non-banks as borrowers and lenders. We analyse the effects of key global liquidity drivers, including risk and advanced

[3] These observations pertain to volumes of cross-border flows, not to co-movements of asset prices. During this same broad period, co-movements in international asset prices continue to be at least as strong and sensitive to global risk sentiment and liquidity conditions as pre-crisis state. This type of evidence does not support de-globalization.

[4] Extensive discussion and cross-country evidence is provided in the March 2017 volume of the *International Journal of Central Banking* in which a range of country and cross country studies document experiences through global banks and hosted affiliates of foreign banks. Buch and Goldberg (2017) provide a meta-analysis of findings.

economy monetary policy, and tests conjectures about why and how these effects change over time. Our analysis ties together the dynamism in the effects of different global factors, showing the roles of micro-banking characteristics, composition of creditors, monetary policy regimes, and prudential policies of both borrowers and creditors.

3. Empirical strategy

The empirical strategy implemented has three main parts. The starting point is the international capital flow and global liquidity specification whereby international financial flows are explained by global (push) and country-specific (pull) drivers. We replicate findings from that literature as a baseline before delving into differences in sensitivities to global (and other) factors over time, as well as across different borrower groups (banks and non-banks) and across different types of financing instrument (international claims and international debt securities). After having identified significant changes in patterns pre- and post- global financial crisis, the second part of the empirical strategy focuses on the pre- versus post patterns of changes in global liquidity sensitivity to global factors, with a specific set of tests for changes in the composition versus the behaviour of creditors. The patterns of composition and behaviour then are related to ex ante balance sheet conditions and regulatory policies of lending banking systems. The last part of the empirical strategy relates period-by-period time variation in the effects of advanced economy monetary policy and risk sensitivity to evolving creditor bank balance sheet characteristics and to degrees of divergence across monetary policies of advanced economies.

3.1 Baseline analysis

The baseline model for global and local factors in international capital flows follows the literature by introducing push global factors and pull local factors, and is given by:

$$GrRateY_t^j = \beta_1 \Delta FFR_t + \beta_2 logVIX_t + \beta_3 \Delta logGlobalGDP_t + \beta_4 \Delta SovRating_t^j + \beta_5 ChinnIto_t^j + \beta_6 \Delta logGDP_t^j + \mu^j + \varepsilon_t^j \quad (1)$$

where j denotes country and t is time. Our baseline specification considers the issue of international capital flows and global liquidity drivers from the perspective of the borrowing country. Global liquidity is divided into component cross-border flows by instrument and by type of borrower, with these components explored separately and in aggregate. For our analysis, Y_t^j can be cross-border loans - to all sectors, to banks, to non-banks - or international debt securities - issued by all sectors, by banks or by non-banks. As is standard in the literature, the model is expressed in stationary variables to avoid problems of spurious correlations. The international flows on the left-hand side of the equation are expressed in growth rates. The right-hand-side of the equation contains three global liquidity drivers - the US federal funds rate (as a gauge for the stance of US monetary policy), the VIX (as a measure global risk conditions) and global GDP (as an indicator of global economic activity). As the US federal funds rate does not reflect all of the monetary policy interventions for the post GFC period, we use the Wu-Xia shadow rate measure (Wu and Xia, 2016) as a proxy to reflect both

conventional and unconventional monetary policies.[5] The local factors corresponding to borrowing country j and flow type include sovereign credit ratings, the Chinn-Ito index of financial openness (Chinn and Ito, 2008) and local GDP growth. The latter measures overall economic performance. Sovereign ratings proxy the role of country risk and the perceived creditworthiness of borrowers by country. The Chinn-Ito index gauges the degree of capital account openness. The Fed funds rate and the sovereign ratings are in first differences, while local and global GDP are in growth rates. The Chinn-Ito index is in levels and the VIX enters the equation in logs.[6] The model is estimated under the assumption that the two key global liquidity drivers, the Fed funds rate and the VIX, are exogenous when controlling for local and global GDP, government ratings and degree of financial openness.

As both anecdotal evidence and the literature discussion of phases of financial globalization hint at the presence of a possible structural break around the global financial crisis, we modify the full time period approaches of the literature and allow for shifts in the drivers of global liquidity. Rather than exogenously imposing a particular break date, we conduct a formal search for an endogenous structural break in the parameters of the model. Using the tools developed in Bai (1994, 1997), Kurozumi (2002) and Carrion-i-Silvestre and Sansó (2006), for each quarter T starting in 2007:Q1, we estimate the following equation:

$$GrRateY_t^j = \beta' X_t^j + \mu^j + I(t \geq T)(\kappa + \gamma' X_t^j) + \varepsilon_t^j \quad (2)$$

where

$$X_t^j = (\Delta FFR_t, logVIX_t, \Delta logGlobalGDP_t, \Delta logGDP_t^j, \Delta SovRating_t^j, ChinnIto_t^j)'$$

and $I(t \geq T)$ is an indicator function that takes the value 1 when $t \geq T$ and 0 otherwise. Notice that for each candidate break date T, all the parameters of equation (2) are different. For each type of cross-border flow Y and each quarter T we can compute the sum of squared residuals of the regression in order to get a sequence $\{SSR_T^Y\}_{T \geq 2007:Q1}$. The most likely candidate for the break is the date that minimizes the sequence, hence maximizing the fit of the model: $T_{break}^Y = argmin_{T \geq 2007:Q1}\{SSR_T^Y\}$.

Once we detect the endogenous date for the break (T_{break}^Y), we re-estimate the baseline model with the appropriate break dummy and use a Wald test on κ and γ' to determine whether the break is statistically significant. The vector β' captures the sensitivities of international financial flows to the drivers in X_t^j before the break. The sum $\beta' + \gamma'$ captures the post-break sensitivities.

Given our special interest in the sensitivities of international loan and bond flows to US monetary policy and global risk conditions, we then conduct an additional closer investigation of the evolution of the respective estimated coefficients. In particular, we examine the hypothesis that the post-crisis paths of the above sensitivities may have been altered before and after the 2013 taper tantrum. For this purpose we sequentially estimate equation (2) with the appropriate break date, starting with the sample 2000:Q1 – 2013:Q1 and adding one

[5] As there are multiple shadow policy rates available in the literature, we perform extensive robustness checks using alternative indicators of U.S. monetary policy. The main findings are robust to alternative proxies.

[6] The Chinn-Ito index is only available at an annual frequency. We have tested the robustness of the results by using a quarterly linear interpolation of the Chinn-Ito index and by eliminating the index from the regressions. In both cases, the main results of the study remain qualitatively similar.

quarter at time until we reach our full sample (2000:Q1 – 2015:Q4). This procedure generates a distinct set of parameter estimates for each sample-end quarter from 2013:Q1 through 2015:Q4. This allows us to track how sensitivities to US monetary policy and global risk conditions have evolved during that period. As with the baseline analysis, for this approach to time variation Y_t^j can be cross-border loans to all sectors, to banks, to non-banks, can be international debt securities issued by all sectors, by banks or by non-banks.

3.2 Decomposing the post-crisis shifts in sensitivities

The global liquidity series exploration described in section 3.1 utilizes gross flows data from the perspective of borrowers in countries indexed by *j*. As the specifications introduce controls for local drivers of liquidity, the evolution of estimated global factor coefficients β_1 and β_2 , on advanced economy monetary policy and risk, are associated with creditors. In particular, changes in estimated β_1 and β_2 are attributable to a combination of shifts in the composition of international creditors (a *compositional* component) and shifts in the sensitivity of flows from country creditors vis-a-vis advanced economy monetary policy and risk metrics (a *behavioural* component). For any class of creditor and borrower type, the aggregate sensitivities of international bank lending flows to global factors (β_1 and β_2) can be expressed as weighted averages of the national creditor-specific sensitivities to global factors (β_1^i and β_2^i). While this observation is general, as we have and analyse detailed information from the perspective of creditor banking systems at the country level (but do not have creditor data for international debt securities financing, our derivation of the decomposition takes the perspective of international bank lending.

We start by re-writing specification (1) as:

$$\frac{S_t^j}{S_{t-1}^j} - 1 = \beta_1 \Delta FFR_t + \beta_2 logVIX_t + \beta_3 \Delta logGlobalGDP_t + \beta_4 \Delta SovRating_t^j + \beta_5 ChinnIto_t^j + \beta_6 \Delta logGDP_t^j + \mu^j + \varepsilon_t^j \quad (3)$$

where S_t^j is the outstanding stock of international bank lending to the residents of country *j* at the end of period *t*. The national banking system-specific counterpart to specification (1) is then written as:

$$\frac{S_t^{i,j}}{S_{t-1}^{i,j}} - 1 = \beta_1^i \Delta FFR_t + \beta_2^i logVIX_t + \beta_3^i \Delta logGlobalGDP_t + \beta_4^i \Delta SovRating_t^j + \beta_5^i ChinnIto_t^j + \beta_6^i \Delta logGDP_t^j + \mu^{i,j} + \varepsilon_t^{i,j} \quad (4)$$

Expanding and simplifying yields:

$$\frac{S_t^j}{S_{t-1}^j} - 1 = \frac{\sum_i S_t^{i,j}}{\sum_i S_{t-1}^{i.j}} - 1 = \sum_i \left(\frac{S_t^{i,j}}{S_{t-1}^{i,j}} * \frac{S_{t-1}^{i,j}}{\sum_i S_{t-1}^{i,j}} \right) - 1 = \sum_i \left\{ \left(\frac{S_t^{i,j}}{S_{t-1}^{i,j}} - 1 \right) w_{t-1}^{i,j} \right\} \quad (5)$$

where the weight for each banking system $w_{t-1}^{i,j} = \frac{S_{t-1}^{i,j}}{\sum_i S_{t-1}^{i,j}}$ equals the respective share of the outstanding stock of flows for which it accounts. Combining (4) and (5), the baseline regression

specification implies that the sensitivities to the federal funds rate (β_1) and to the VIX (β_2) can be expressed as weighted averages of the respective sensitivities (β_1^i) and (β_2^i) for the individual lending national banking systems:[7]

$$\beta_1 = \sum_i \{w_{1,t-1}^{i,j} \beta_1^i\} \text{ and } \beta_2 = \sum_i \{w_{2,t-1}^{i,j} \beta_2^i\}. \quad (6)$$

The compositional component is captured by the $w_1^{i\prime}s$ and $w_2^{i\prime}s$ and the behavioral component is captured by the $\beta_1^{i\prime}s$ and the $\beta_2^{i\prime}s$. The compositional factors $w_1^{i\prime}s$ and $w_2^{i\prime}s$ are directly observable and can be obtained from the data on bilateral international claims. Meanwhile, the behavioral factors $\beta_1^{i\prime}s$ and $\beta_2^{i\prime}s$ are estimated using a variant of the baseline specification.

Using this approach, we pivot from the borrowing country perspective taken in section 3.1 to instead using data from the creditor country perspective. The BIS consolidated banking statistics (CBS) is a dataset from the creditor country perspective that contains information on banks' international claims defined as the sum of cross-border claims and local claims denominated in foreign currencies. The data is bilateral and contains information on the nationality of the lending banks *i* and on the residence of the borrower *j*. By lending country *i* and for estimation periods corresponding to those defined in our first stage of the analysis (pre-break period and post break periods), the baseline model is estimated similarly to model (1), to generate lending country specific estimates of behavioural factors $\beta_1^{i\prime}s$ and $\beta_2^{i\prime}s$. Thus, we observe the creditor country history of changes in sensitivities and the precision of estimates of those sensitivities for global liquidity flows through international banks to both bank and non-bank counterparties.

3.3 Identifying the determinants of the post-crisis behavioural and compositional changes

The third main empirical element of our analysis is a further investigation into the changing drivers of global liquidity. We conduct a diff-in-diff analysis that compares the pre- and post-crisis sensitivities to global factors and the shares of national banking system lenders. The analysis considers which pre-crisis characteristics of banking systems and policies are associated with changes to outcomes post-crisis.

Among the potential drivers of the structural changes in creditor country shares in global liquidity and creditor behaviours are bank balance sheet conditions and regulatory policies. The bank conditions include the initial (pre-crisis) level of bank capitalization and other ex-ante balance sheet characteristics. Bank capital acts as a buffer against contingencies triggered by monetary policy shocks and can limit the effect of a credit crunch in a crisis characterized by increased global uncertainty and volatility (Gambacorta and Shin, 2016). We construct *ex ante* balance sheet characteristics at the national banking system level by using bank-level Bankscope data, aggregated at the country level and corresponding to averages over dates included in specific estimation periods. We test whether the shifts in sensitivities and weights have been driven by the use of specific prudential policy tools using the IBRN Prudential Instruments Database from the perspective of lending countries as described in

[7] A detailed explanation of the decomposition of post-crisis shifts in sensitivities is reported in Annex A.

Cerutti, Correa, Fiorentino and Segalla (2017). This database covers prudential instruments such as capital requirements, loan-to-value limits, local currency reserve requirements, and interbank exposure limits.

We test for the main drivers of the shift in sensitivities to global factors by estimating regressions in which the changes in the estimated coefficients are regressed on a set of pre-crisis variables. In particular, we estimate the following regressions:

$$(\beta^i_{1,k,PostBreak} - \beta^i_{1,k,PreBreak}) = \gamma_1{}'F^i_{2008} + \zeta_1{}'P^i_{2008} + \theta_{1,k} + \varepsilon^i_{1,k} \quad (7)$$

$$(\beta^i_{2,k,PostBreak} - \beta^i_{2,k,PreBreak}) = \gamma_2{}'F^i_{2008} + \zeta_2{}'P^i_{2008} + \theta_{2,k} + \varepsilon^i_{2,k} \quad (8)$$

where $(\beta^i_{1,k,PostBreak} - \beta^i_{1,k,PreBreak})$ is the difference in coefficients for ΔFFR and $(\beta^i_{2,k,PostBreak} - \beta^i_{2,k,PreBreak})$ is the difference in the coefficients for $logVIX$ taken from equation (4), estimated for lending country i and borrowing sector *k* (banks, non-bank private sector and public sector). $\theta_{1,k}$ and $\theta_{2,k}$ are vectors of borrowing sector fixed effects. The vector F^i_{2008} includes two banking system indicators: i) the capital-to-asset ratio; ii) the average bank size. The vector P^i_{2008} represents the prudential stance and it includes a range of prudential instruments. We use pre-break characteristics in order to limit endogeneity issues. Since the dependent variable in those regressions is a function of estimated coefficients, each with an associated standard error around it, we use meta-regressions techniques[8].

We likewise examine the drivers of the shifts in lending banking system weights in flows to bank and non-bank borrowers, applying a similar regression specification to $(w^i_{k,PostBreak} - w^i_{k,PreBreak})$:

$$w^i_{k,PostBreak} - w^i_{k,PreBreak} = \gamma'_w F^i_{2008} + \zeta_w{}'P^i_{2008} + \chi'_w B^i_{2008} + \theta_{w,k} + \varepsilon^i_{w,k} \quad (9)$$

where B^i_{2008} is a vector containing the following additional pre-break banking system indicators: i) the deposit-to-total funding ratio, ii) the ratio of net interest income to total income, iii) the ratio of local claims to foreign claims.

3.4 Examining the drivers of the evolution of post-crisis sensitivities

The final part of our empirical analysis takes a time series approach in order to identify the main drivers of the evolution of post-crisis sensitivities. We conjecture that this evolution may be influenced by the overall advanced economy monetary policy stance and by the characteristics of the creditor national banking systems. One possible driver of the post-crisis evolution in sensitivities could be the degree of monetary policy convergence among advanced economies (AEs). The reaction to U.S. monetary policy as a global liquidity driver could be especially pronounced if it is a signal for a broader based set of expansionary policies across AE countries. In the period between the global financial crisis and the 2013 Fed taper

[8] The meta-regression allows for residual statistical heterogeneity in the results of different estimation (between-study variance) by assuming that the true effects follow a normal distribution around the linear predictor (Stanley and Jarrell, 1989). The meta-regression can be formally defined as: $y_i|\theta_i \sim N(\theta_i, \sigma_i^2)$, where $\theta_i \sim N(x_i\beta, \tau^2)$ therefore: $y_i \sim N(x_i\beta, \sigma_i^2 + \tau^2)$, where β is the vector of estimated effects of study characteristics. This type of equation is estimated by weighted least-squares, in which the weight of each estimated coefficient depends inversely of its variance and corresponds to the inverse of the sum of two standard deviations (σ^2, τ^2).

tantrum, there was considerable convergence between the monetary policies of advanced economies, all of which were conducting various forms of quantitative easing to stimulate the real economy. In 2013 the Federal Reserve signalled that it would start tapering its bond buying program. As the central banks of other advanced economies, most notably the European Central Bank and the Bank of Japan, did not follow suit, the monetary policies of advanced economies diverged through the end of our estimation period in 2015. Thus, we conjecture that the sensitivities of the main global liquidity components to of US monetary policy could be stronger during the convergence period and weaker as policy diverges.

We also conjecture that banking system characteristics, such as lenders' dominant business models and profitability, may have also driven the post-crisis evolution in sensitivities. Institutions engaging mainly in commercial banking activities have lower costs and more stable profits than those more heavily involved in capital market activities, mainly trading. Also, retail banking has gained ground post-crisis, reversing a pre-crisis trend (Roengpitya et al., 2014).[9] The willingness to lend to riskier counterparties is particularly strong in low interest rate environments, especially when these are likely to be sustained. Thus, we conjecture that reach for yield behaviours, a push factor in global liquidity, may be stronger for the banking systems that had more depressed profitability and return on assets.

This last section of empirical results thus examines the relevance of lending banking system characteristics and the degree of divergence among advanced economies' monetary policies by interacting the respective variables with the coefficients of ΔFFR and $logVIX$ in equation (2). The resulting model is:

$$\begin{aligned} GrRateY_t^j = {} & \beta' X_t^j + \left[\nu + \eta' \begin{pmatrix} \Delta FFR \\ logVIX \end{pmatrix}_t\right] polDiv_t + \left[\varrho + \xi' \begin{pmatrix} \Delta FFR \\ logVIX \end{pmatrix}_t\right] Prof_t^j + \mu^j \\ & + I(t \geq T_{break}^Y)\left\{\kappa + \gamma' X_t^j + \left[\omega + \chi' \begin{pmatrix} \Delta FFR \\ logVIX \end{pmatrix}_t\right] polDiv_t + \left[\delta + \psi' \begin{pmatrix} \Delta FFR \\ logVIX \end{pmatrix}_t\right] Prof_t^j\right\} + \varepsilon_t^j \end{aligned} \tag{10}$$

where $polDiv_t$ is a proxy for the monetary policy divergence between the US and other advanced economies; $Prof_t^j$ is a weighted average of a proxy for the business models of banking systems lending to country j. The weights are given by equation (5). The time-varying, borrowing-country-specific post-crisis sensitivity to ΔFFR is captured by $\beta_1 + \eta_1 polDiv_t + \xi_1 Prof_t^j + \gamma_1 + \chi_1 polDiv_t + \psi_1 Prof_t^j$.

4. Data

We utilize three databases to capture the main components of global liquidity: the BIS Locational Banking Statistics (LBS), the BIS International Debt Securities Statistics (IDSS), and BIS Consolidated Banking Statistics (CBS). The BIS LBS captures the outstanding claims and liabilities of internationally active banks located in 44 BIS LBS reporting countries[10] against

[9] The link between business models and lending is developed, among others, in Lamers et al. (2016) and Martinez-Miera and Repullo (2015).

[10] The complete list of BIS LBS reporting countries is provided at http://www.bis.org/statistics/rep_countries.htm.

counterparties residing in more than 200 countries. Banks record their positions on an unconsolidated basis, including intragroup positions to capture international flows between offices of the same banking group. The data are compiled following principles that are consistent with balance of payments statistics. The LBS statistics capture around 95% of all cross-border interbank business (Bank for International Settlements, 2015). At the same time, the counterparty sector breakdown available in the BIS LBS enables us also to distinguish between cross-border bank lending to bank and non-bank borrowers. These data series capture the international flows to bank and non-bank borrowers from the borrower perspective. The BIS CBS are mainly used in our analysis creditor for the bank perspective. We use them to compute lender-specific sensitivities to the global factors, as well as the relative importance of lending countries for a given borrowing country in terms of capital flows. The BIS IDSS data capture borrowing in money and bond markets. International debt securities (IDS) are defined as those issued in a market other than the local market of the country where the borrower resides (Gruić and Wooldridge, 2012). They encompass what market participants have traditionally referred to as foreign bonds and eurobonds. The sample used for the empirical analysis consists of quarterly data from Q1 2000 to Q4 2015. On the borrowing side, we focus on a set of 64 countries, which includes both, Advanced Economies (AEs) and Emerging Market Economies (EMEs). On the bank lending side, we use data on the positions of all 44 BIS LBS and 31 CBS reporting countries.[11]

The typical lenders and borrowers connected by each flow type differ considerably in composition and size, as illustrated within Table 1. Cross-border loans are typically supplied by internationally-active banks, which tend to be relatively large. Meanwhile, the creditors in international debt securities markets are usually non-bank financial intermediaries, such as pension funds, insurance companies, money market mutual funds, and hedge funds. The variation on the borrower side is even greater. International bond issuance by non-banks tends to be dominated by sovereigns and large non-financial corporates. The latter are also important players on the borrowing side of the cross-border bank loan market, which also channels funds to export/import firms and leveraged non-bank financials.

There are three global factors in our analysis. Global real GDP growth measures global economic activity. The second global factor is changes in stance of US monetary policy. The empirical literature discussed in Section 2 mainly corresponds to the period prior to the introduction of unconventional monetary policy and exclusively uses a short-term policy rate. However, this approach may not be appropriate for the full post-crisis period. Monetary policy at the zero lower bound is a defining feature of the post-crisis period, and changes in communications, interest on effect reserves and quantity easing actions became more instrumental. Accordingly, there is extensive debate on whether a single metric can convincingly serve as a sufficient statistic for changes in U.S. monetary conditions. For our purposes, we use the Wu-Xia policy measure (Wu and Xia, 2016) as a baseline for the "US FFR". By this construct, the effective US Federal Funds target rate is used prior to Q4 2008 and the Wu-Xia estimates of the shadow Federal Funds rate are used from Q1 2009 through end of 2015 (Graph 2, left panel). While a number of alternative shadow rates have been constructed, all shadow rates are sensitive to the underlying modelling assumptions utilized. *Changes* in shadow policy rates have been documented to be highly correlated across a number of the

[11] The complete lists of all borrowing countries and lending national banking systems are available in Annex B.

alternative shadow rate series. We conduct robustness analysis (section 6) using alternatives, showing the robustness of our results.

The third global factor is a measure of global risk conditions. Following the global liquidity literature, we utilize the VIX index of the implied volatility in S&P500 stock index option prices from Chicago Board Options Exchange (CBOE) (Graph 2, right panel).

Three borrowing country variables (pull factors) are included in baseline specifications: local real GDP growth, sovereign ratings, and the degree of financial openness. For each borrowing country, the sovereign ratings variable is defined as the average ratings across the three major credit ratings agencies (S&P, Moody's and Fitch). The degree of financial openness is captured by the Chinn-Ito index (Chinn and Ito, 2008), normalized between 0 and 1.

The IBRN Prudential Instruments dataset covers widely-used prudential instruments, keeping track of the intensity of their usage in 64 countries between 2000 and 2014 at a quarterly frequency. The instruments that are covered are: general capital requirements, sector-specific capital requirements (split into real estate credit, consumer credit, and other), interbank exposure limits, concentration limits, loan-to-value (LTV) ratio limits, and (local currency and foreign currency) reserve requirements. We focus on the three prudential policy instruments that have been shown to have the largest impact on international bank lending: loan-to-value ratio caps, capital requirements and local currency reserve requirements (Avdjiev et al., 2017; and Buch and Goldberg, 2017).[12]

The balance sheet characteristics of national banking systems are constructed using Bankscope data. We obtain the balance sheet items of interest for the set of internationally active banks that report to the BIS consolidated banking statistics, and then aggregate bank-level characteristics to national banking system-wide variables, using weighted averages across the individual banks of a given nationality. Data are adjusted for mergers and acquisitions to correct for balance sheet jumps that are unrelated to lending (Brei et al., 2013). We gather data on i) capital to total assets, ii) average bank size, iii) deposits to total assets, iv) net interest income over total income, v) net interest income to total assets.

Two bank business model measures are considered: i) an income diversification ratio (defined as net interest income to total income); ii) net interest income to total assets. The first indicator ranges from 0 to 1 and indicates the fraction of a bank's profitability that derives from traditional intermediation activity (i.e. lending and deposits). If a bank has a large portion of non-interest income (trading income, fees and commissions for services) than this indicator tends lower values. The second indicator is the return per unit of assets that derives from traditional intermediation activity. It represents the profitability of intermediated assets that is obtained by the bank getting deposits and supplying loans.

As a proxy for monetary policy divergence among advanced economies, we take the difference between the 2-year futures on the policy rate for the United States and the average of the 2-year futures for the United Kingdom, Switzerland, Japan and a group of "core" Eurozone countries (Austria, Belgium, Germany, Finland, France, the Netherlands, Spain).[13]

[12] Cerutti et al. (2017) provide an extensive discussion of the properties of the quarterly changes in these prudential instruments and the cumulative changes over time.

[13] Summary statistics for the explanatory variables used in our empirical analysis are presented in Table C1 in Annex C.

5. Evidence on global liquidity drivers

5.1 Baseline results

Our empirical investigation begins with the baseline specification in equation (1) as a way to replicate prior global liquidity results. The estimated coefficients for the entire sample 2000:Q1 – 2015:Q4, presented in Table 2, are largely in line with those obtained in the existing literature. Using data on international bank flows and international debt securities issuance from the bank and non-bank debtor perspective, the results from the baseline model indicate that an increase in global risk conditions (measured by the VIX) has a negative and strongly statistically significant effect on all flows we examine. The US federal funds rate has a sharply negative impact on cross-border bank loans. Its estimated impact on international debt securities is also negative, albeit only marginally statistically significant. Local factors are also statistically significant drivers. Borrowing countries with higher GDP growth rates and with better sovereign credit ratings tend to attract more cross-border loans. Meanwhile, the degree of financial openness, as reflected in the Chinn-Ito index, has a positive (and statistically significant) effect on the international bond flows, especially to banks.

As described in Section 3.1. we formally test whether the above estimated coefficients from equation (1) are stable over time. Rather than exogenously imposing an ad-hoc break date, we test for its presence and exact timing endogenously. We find that the most likely break date for both cross-border loan flows and international bond flows is 2009:Q1. Wald (or Chow) tests on the coefficients κ and γ' in equation (2) indicate that the break is statistically significant for the global liquidity components that we examine.[14]

Table 3 summarizes the estimated sensitivities to the main global drivers (the VIX and the federal funds rate) during the pre-break and the post-break periods, respectively. Two sets of estimates are provided for the post-crisis period – one for the full sample (ending in Q4:2015) and one for a sub-sample ending in Q1:2013. The latter set of results allows us to examine whether the 2013 Fed taper tantrum marked a turning point in the post-crisis sensitivities to global factors.

The results confirm that the relationship between the main global factors and international capital flows has changed profoundly since the Global Financial Crisis. Sensitivities of all flow types to US monetary policy increased sharply between the GFC and the taper tantrum. This is true for all flow types we examine and for all borrowing sectors. The impact of US monetary policy on cross-border loans, which was already negative and statistically significant during the pre-crisis period, rose even further in the immediate aftermath of the GFC. More concretely, while prior to the crisis a 25-basis point decline in the federal funds rate was associated with an 80-basis point rise in the quarterly growth rate of cross-border bank lending, in the aftermath of the crisis was associated with a 202-basis point increase in the same growth rate. The respective negative impact on international bond issuance, which was not statistically significant prior to the crisis, also increased considerably after the GFC. In quantitative terms, the impact of a 25-basis point drop in the federal funds

[14] Test results are available upon request.

rate on international bond issuance surged from 36 basis points before the crisis to 202 basis points after the crisis.

Following the 2013 taper tantrum, sensitivities to US monetary policy reverted towards their respective pre-crisis levels, especially for cross-border loans. Once the sample is extended to include the post-taper tantrum period, a 25-basis point decline in the federal funds rate becomes associated with a 92-basis point increase in the quarterly growth rate of cross-border bank loans, a level of responsiveness much closer to the one observed prior to the crisis. The responsiveness of international bond flows also reverted, but not by as much. Nonetheless, all the impact of changes in US monetary policy on all flow types remained negative and highly statistically significant.

The post-crisis period also is characterized by a substantial decline in the sensitivity of cross-border bank loans to global risk conditions. The estimated effect of the VIX, which was negative and highly statistically significant prior to the crisis, weakened considerably by Q1:2013 and even became insignificant by the end of the sample (in Q4:2015). Whereas prior to the crisis a one-standard deviation increase in the VIX was associated with a 134-basis point contraction in the quarterly growth rate of cross-border bank lending, after the crisis it only caused an 11-basis point decline in the same growth rate.

The post-crisis evolution of the sensitivities of aggregate global liquidity flows (i.e. the sum of international bank loans and bond flows) was in line with the respective evolutions for the main global liquidity components. Namely, the responsiveness of aggregate flows to US monetary policy rose sharply between the GFC and the 2013 taper tantrum. It subsequently reverted towards pre-crisis levels, but remained at relatively high levels. By contrast, aggregate global liquidity flows became much less sensitive to global risk since the GFC.

There has been some convergence in the global factor sensitivities of the two main global liquidity components. Table 4 shows the difference between the sensitivities of cross-border loans and international debt securities to the global factors, before and after the GFC. In the pre-crisis period, the differences were mostly negative and significant, indicating that cross-border loans were significantly more sensitive than international debt securities to both global risk conditions and US monetary policy. In the post-crisis period, most differences are no longer statistically significant, signalling that the two types of flows have become more similar in their responsiveness to global factors.

5.2 Decomposing the shifts in sensitivities to global factors

As described in Section 3.2, the shifts in the sensitivities of external flows to global factors can be decomposed into a compositional component and a behavioural component. The factors that capture the composition of lending national banking systems (the $w_1^i's$ and the $w_2^i's$) are directly observable and are obtained from the CBS matrix of bilateral stocks of international claims. Meanwhile, the factors that capture the behavioural component, i.e. the national banking system-specific sensitivities to global factors (the $\beta_1^i's$ and the $\beta_2^i's$) are obtained as the estimated coefficients on the respective global factors in the national banking system-specific regressions presented in equation (6).

Graph 3 presents the lending national banking system weights for the pre- and post-crisis periods. It illustrates that the post-crisis period has seen a pullback from the relative

share of euro area banks in international lending and an expansion by banks from advanced economies outside the euro area. Most notably, there have been sizeable declines in the international lending shares of German, Belgian and Dutch banks, while the international presence of US, UK and Japanese banks has grown significantly during the same period. The above general pattern tends to hold for international lending to bank, non-bank and public borrowers.

Having obtained the pre- and post-crisis lender-specific weights and lender-specific sensitivities to global drivers, we estimate the contributions of the behavioural components (the first terms on the right-hand side of equations (7) and (8)) and compositional components (the second terms on the right-hand side of equations (7) and (8)) to the shifts in sensitivities from the perspective of borrowers.[15] Recall that a borrower can experience a changing sensitivity of financing flows to global factors if there is an evolution in the composition of creditors, where the creditors have distinct sensitivities, and if there is an evolution of the behavioural sensitivities of creditors. The results from the decompositions of borrower sensitivities into the composition and behaviour of creditors are summarized in Graph 4.

The behavioural component dominates the shifts in realized borrower sensitivities to US monetary policy (Graph 4, left-hand panel). For all three borrowing sectors, the estimated contributions of the behavioural component are negative (i.e. they increase the absolute value of the estimated sensitivity). The contributions of the behavioural component dominate the respective contributions of the compositional component. These results show strongly that the post-crisis increases in the sensitivity of international bank lending flows to US monetary policy are driven by increase in the sensitivities of individual banking systems rather than by a shift in the composition of international lending from less to more sensitive banking systems.

The decomposition of the sensitivities to the VIX show that the contributions of the compositional component are all positive and much larger than their counterparts for the US monetary policy sensitivities (Graph 4, right-hand panel). The behavioural component is not as dominant as in the case of US monetary policy. The behavioural component plays a significant role only for lending to the public sector. When it comes to lending to the non-bank private sector and interbank lending, the overall declines in sensitivities to the VIX are clearly driven by the compositional component.

The sensitivities of international bank lending flows to the public sector increase considerably during the post-crisis period vis-à-vis both the US monetary policy and the VIX. These results could be interpreted as evidence that banks have adjusted treatment of sovereign risk since the crisis. Such an interpretation would be consistent with evidence that banks treated (most of) their sovereign exposures as virtually risk-free before the crisis, but started to assess sovereign risk in a more realistic manner after the crisis (Acharya et al., 2013; Farhi and Tirole, 2016; De Grauwe and Ji, 2013).

[15] By design, these decompositions represent approximations of the underlying estimation procedure. Even though the "synthetic" sensitivities derived as a weighted average of the lender-specific sensitivities tend to be very close to the global sensitivities obtained using the benchmark regression specification, the two measures do not overlap perfectly.

5.3 Determinants of the post-crisis shifts in sensitivities and weights

As a key issue is uncovering the main drivers of the shift in the lender-specific sensitivities to global factors, the next set of results provide insights in a diff-in-diff framework by regressing the change in the (pre- and post-break) coefficients on a small set of potential explanatory (pre-crisis) variables per equations (7) and (8). The results for changes in the sensitivities to US monetary policy $\left(\beta^{i}_{1,\mathrm{k},PostBreak} - \beta^{i}_{1,\mathrm{k},PreBreak}\right)$ are reported in Columns (I) – (III) of Table 5. Banking systems that were better capitalised pre-GFC experienced a smaller change in the sensitivity of their international lending to US monetary policy in the post-crisis period.[16] This result is in line with the strand of literature which argues that well-capitalised banks are perceived as less risky by depositors and other bank creditors, have easier access to funding, and are, consequently less affected by fluctuations in funding costs (Gambacorta and Shin, 2016). The result also accords with cross-country evidence that liquidity risk transmission internationally is weaker for banks with more capital and more stable funding sources.[17]

We examine the robustness of the above result to controlling for various measures of the prudential policy stance at the time of the structural break. It turns out that the statistical significance of the banks' capitalization levels is robust to controlling not only for the cumulative prudential measure index (Column I), but also to controlling for the cumulative loan-to-value ratio cap index (Column II) and cumulative local currency reserve index (Column III). None of the above three cumulative prudential control variables is statistically significant.[18]

The right-hand panel (Columns IV – VI) of Table 5 investigates the determinants of the structural break in the sensitivity of international bank lending to global risk. The dependent variable in those specifications is $\beta^{i}_{1,\mathrm{k},PostBreak} - \beta^{i}_{1,\mathrm{k},PreBreak}$ (estimated from equation (8)), for lending country i and borrowing sector k. As in the case of the sensitivities to US monetary policy, the main determinant of the changes in the sensitivities to global risk also appears to be the capitalization level of the respective national banking system. The better capitalized a given banking system was at the time of the structural break, the more likely it was that the sensitivity of its international lending to global risk declined during the post-crisis period.

The results indicate the cumulative index for local reserve requirements is also a statistically significant determinant of the post- versus pre- changes in the global liquidity sensitivities to global risk. Jurisdictions with tighter local reserve requirements at the time of the break experienced a smaller change in the sensitivity of their cross-border lending to global risk. By contrast, the cumulative prudential measure index and the cumulative loan-to-value ratio cap index are not statistically significant for the risk effects.

We next examine the main drivers of the shifts in the composition of international lending (approximated by the lending weights defined above) between the pre- and the post-

[16] Since the differences between the (pre- and post-break) estimated parameters tend to be negative, a positive value of the coefficients in the meta-regressions implies a smaller change in the (pre- and post-break) sensitivities.

[17] Strahan et al. (2011) has similar findings in a domestic lending setting in response to liquidity risk changes. Buch and Goldberg (2015) and related studies of the International Banking Research Network published in *IMF Economic Review* 2015 provide related evidence for international claims.

[18] Graph C1 shows the evolution of the three prudential policy indices. We could not include the cumulative index for capital requirements measure since all policy actions for that measure have taken place during the post-crisis period (middle panel).

crisis periods. We estimate equation (9), in which the difference in lending national banking system weights before and after the break ($w^{i}_{\mathrm{k},PostBreak} - w^{i}_{\mathrm{k},PreBreak}$) is regressed on a set of pre-crisis business model indicators. The dependent variable can be visualised as the differences in the pre- and the post-crisis weights displayed in the histograms in Graph 3.

The results, reported in the first column of Table 6, indicate that banking systems that were more likely to gain market share during the post-crisis period were those that were ex-ante better capitalized. International lending weights also increased for banking systems that had higher shares of deposits funding and total income from traditional sources of intermediation activity, as well as for those with a larger portion of foreign lending booked locally by foreign subsidiaries. The result that links cross-border lending expansion to deposit ratios is interesting as market funding was under stress during the global financial crisis. The ratio of deposits to total liabilities is typically used to measure a bank's contractual strength. Banks that have a large deposit base suffer lower adjustment costs in their funding (Berlin and Mester, 1999).

Our results are consistent with research concluding that a key transmission channel of the crisis was the dislocation in bank funding markets. Amiti et al. (2016) find that banks which relied more on wholesale funding and cross-currency swaps found themselves unable to roll over their positions during the most severe quarters of the crisis. Gambacorta and Marques (2011) find that the proportion of deposit funding was a key element in assessing banks' ability to withstand adverse shocks. The results also accord with findings of the IBRN research initiative on the impact of prudential policy on international bank lending (see Buch and Goldberg, 2017). Spillovers of interbank exposure limits through foreign bank affiliates differ in degree across banks not only in relation to banks' illiquid asset shares, but also with respect to deposit shares, and the internal capital market positions with their parent banks.

The results on the role of the ratio of interest income to total income are interesting, as this measure is a proxy for the importance of traditional intermediation activities. The positive coefficient on this ratio indicates that banking systems whose business model relied more on traditional intermediation activities experienced an increase in their share of the supply of global liquidity. These findings accord with the empirical literature pointing to the vulnerability of banks involved in capital market activities, as opposed to commercial market activities, to shifts in global economic conditions (Roengpitya et al., 2014).

We find that banking systems with higher local lending are more resilient and have increased their lending weight at the expense of banking systems with a different business model. The ratio of local claims over foreign claims indicates the business model used by a banking system to lend abroad. The higher the ratio of local to foreign claims, the more a banking system relies on its subsidiaries and branches abroad as opposed to obtaining foreign claims by dealing with borrowers directly from its headquarters. Local claims have been relatively stable after the crisis, because banks have reduced foreign lending by cutting down operations from their headquarters (Gambacorta and van Rixtel, 2013). Indeed, the latter require a well-functioning wholesale and interbank market, which are very vulnerable to global uncertainty. De Haas and van Horen (2013) find that banks reduced credit less to markets where they operated a subsidiary and where they were integrated into a network of domestic co-lenders.

These results do not change when controlling for various prudential policy measures. The only prudential tool that is statistically significant is the cumulative index for local reserve requirements (Column III): jurisdictions that experienced a tightening in local reserve requirements in the pre-crisis period expanded their cross-border lending by more during the post-crisis period.

5.4 Drivers of the time variation in the post-crisis period

While the previous empirical exercises examined the difference between the pre- and post-crisis period, our next and even deeper analysis of the data reveals considerable variation in parameters of interest across global factors through the post-crisis period. Graphs 5 and 6 display the evolution of the estimated sensitivities to global factors during the post-crisis period. For perspective, the graphs include in each panel a black line designates the pre-crisis estimates of comparable sensitivities.

The post-crisis evolution of the sensitivity to US monetary policy is quite uniform across instruments and borrowing sectors (Graph 5). It is strongest right before the start of the US taper tantrum and becomes gradually weaker afterwards. By the end of our sample, sensitivities remain stronger than during the pre-crisis period for all but one flow types.

The sensitivity to global risk conditions gradually decreases (in absolute value) (Graph 6). Notably, even though sensitivity of global liquidity flows is still significantly lower than zero in mid-2013, this is not the case at the end of our sample. In the case of cross-border loans, the sensitivity to global risk conditions is significantly weaker in the post-crisis period than in pre-crisis.

As discussed in Section 3.3, our conjecture is that the evolution of post-crisis sensitivities may be a function of multiple factors. The first one is the degree of monetary policy convergence among advanced economies. During periods in which the monetary policies of advanced economies move together, a unit change in the federal funds rate could, all else the same, have a larger impact on cross-border bank lending than during periods of divergence. In the former case, changes in the stance of US monetary policy could have a signalling effect about upcoming matching moves by other AE monetary policy authorities. This effect could amplify the consequences of changes in the federal funds rate for cross-border bank lending.

The second factor could derive from banking system characteristics. Lenders' dominant business models and profitability could affect the responsiveness of their cross-border lending to global factors. In particular, the low-interest rate environment in the post-crisis period may have affected banks that rely primarily in interest income in a different manner from banks with less traditional business models.

The results for testing the role of monetary policy divergence between the US and other advanced economies, and of a weighted average of a proxy for the business models of banking systems lending to country j are shown in Table 7. The monetary policy divergence metric plays a large and highly significant role in driving the sensitivity of international bank lending flows to US monetary policy within the early post-crisis period and contributes to a weakened sensitivity of these international flows post 2013. By contrast, the country banking system characteristics (proxied in the table by the relevance of traditional intermediation

activity) do not appear to be a significant driver of the post-crisis evolution of global factor sensitivities in the majority of the examined cases.

The above set of results has important policy implications. To the extent that the post-crisis convergence of the monetary policies of advanced economies was only a temporary phenomenon, the dramatic increase in sensitivities to US monetary policy may not persist. By contrast, the compositional effect of international lending shares shifting towards better capitalised banking systems, which would naturally lead to more stable bank lending flows, is likely to be much more persistent.

6. Robustness

We conduct three sets of robustness checks. First, we re-estimate all of our benchmark specifications using alternative shadow federal funds rates. Second, we run all bond flow regressions using an alternative international bond flow measure. Third, we test if our main findings are similar for advanced economies versus emerging markets.

6.1 Alternative measures of US monetary policy

The baseline results for the sensitivities to US monetary policy are in part obtained using a constructed measure of the federal funds rate (i.e. a shadow policy rate). The Wu-Xia shadow rate used in the benchmark analysis (Wu and Xia, 2016) is generated by a multi-factor term structure model and assumed to be a linear function of three latent variables which follow a VAR (1) process. The latent factors and the shadow rate are estimated with the extended Kalman filter. The model used by Wu and Xia (2016) is in discrete time and is not prone to the numerical approximation errors associated with alternative shadow rates.

However, the evolving shadow rates literature has several alternative measures, each with its own advantage and disadvantages (for a discussion of trade-offs among the alternative measures, see Lemke and Vladu (2017). For robustness, we consider two alternative shadow rates. The measure developed by Krippner (2014) is based on a two state-variable shadow yield curve model estimated using the iterated extended Kalman filter on month-end US yield curve data from 1985 with times to maturity spanning 0.25 to 30 years. The measure developed by Bauer and Rudebusch (2016) replaces the affine short-rate specification of standard dynamic term structure models with an identical affine process for an unobserved shadow short rate. Among the three alternative shadow policy rates, the Wu-Xia shadow rate that we use in our benchmark analysis tends to be somewhere in between the two alternative shadow rates that we use in our robustness checks.[19].

Table C2 in Annex C reports our baseline estimations using the two alternative shadow rates by Krippner (2014) and Bauer and Rudebusch (2016). The coefficients of the alternative shadow rates are still negative and significant, consistently with the results we obtain using the Wu-Xia rate in Table 2.

[19] This is the case for both levels (Graph C2, left-hand panel) and first differences (Graph C2, right-hand panel).

As a further robustness check, we estimate our baseline model using two-year US Treasury bond rates instead of shadow rate estimates. This allows us to test the sensitivity of our main results to replacing the model-based shadow rates with rates that are based on hard market data. Table C3 in Annex C shows the estimated coefficients when the two-year US Treasury bond rate series is used instead of shadow rate series. The qualitative pattern of the main coefficients is the same as the one in our benchmark specification (see Table 2).

6.2 Alternative international bond flow measures

Our benchmark regressions use international debt securities as measure of bond flows. International debt securities are defined as those issued in a market other than the local market of the country where the borrower resides (Gruić and Wooldridge, 2012). For most borrowing countries and sectors, the universe of international debt securities tends to largely overlap with the universe of debt securities held by external investors. That said, the match is not perfect in all cases for two main reasons. First, securities issued in foreign markets may be purchased and held by domestic residents. Second, domestically issued debt securities could be bought by external investors.

We check the robustness of our results by replacing the international debt securities series used in our benchmark regressions with data on portfolio debt from the Balance of Payments. More concretely, we define our alternative dependent variable as the quarterly growth rate of the respective (gross) outstanding IIP stocks.[20]

As in our baseline results in Table 2, the estimated impact of US monetary policy and global uncertainty on portfolio debt flows is negative and statistically significant (Table C4 in Annex C). This result characterizes aggregate flows and their main sectoral (bank and non-bank) components. As in our baseline estimates, borrower-country GDP growth, sovereign ratings and financial openness have a positive effect on debt securities inflows.

6.3 Advanced economies versus emerging markets

In order to further investigate the main drivers of the above changes in sensitivities for different borrowers, we split the sample of borrowers in sub-samples of those from Advanced Economies (AEs) versus Emerging Market Economies (EMEs). The results reveal that the sharp increases in the post-crisis sensitivities of international capital flows to the federal funds rate characterize both AE and EME borrowers.[21] That said, the increases in the impact of the federal funds rate are more dramatic in the case of AEs. For IDS issued by AE borrowers, sensitivity to the federal funds rate has increased by a factor of four and has switched from being insignificant to being highly significant. The increase in the estimated impact of the VIX on IDS appears to be driven primarily by borrowers in EMEs.

This country-type split also reveals important differences between AE and EME borrowers in the relative importance of global versus local factors. Global factors were much

[20] The exact series we use is '*Portfolio Investment Debt, Liabilities*' (Line *79led*).

[21] The split sample results are presented in Table C5 reported in Annex C.

more important drivers of flows to EMEs than local factors in the pre-crisis period.[22] The opposite was true for flows to AEs. Post-crisis, global factors emerged as the main drivers of flows to AEs, while the importance of the local factors for flows to EMEs grew considerably.

7. Conclusions

The stability and drivers of global liquidity are critically important to the macroeconomic stabilization, growth, and interconnectedness of advanced and emerging market economies. In the aftermath of the global financial crisis, the composition of international capital flows shifted away from bank lending and towards international debt securities. Moreover, there has been a post-crisis redistribution in lending shares across major national banking systems. These dramatic changes raise once more a range of questions about the drivers of global liquidity in the post-crisis international financial system, and the ways that potentially sharp surges and waves might be moderated.

We document important changes that have occurred in the sensitivity to global factors across the main components of global liquidity, cross-border bank loans and international debt securities. Using the BIS international banking and international debt securities statistics for a large panel of countries over 16 years, we find that the impact of US monetary policy changes on all major types of international financial flows to borrowers increased dramatically after the GFC. In the meantime, the responsiveness of cross-border loan flows to global risk conditions has declined significantly.

We show that borrowers experienced these altered sensitivities because of changes that took place in both the composition of creditors and in the behaviour of these creditors. Composition matters since international creditors have distinct characteristics and a change in the distribution of those creditors carries over into the effective sensitivity of flows observed by borrowers. Behavioural changes by international creditors are also important, as some bank business models became more sensitive to US monetary policy and less sensitive to global risk conditions.

The post-crisis rise in the sensitivity of international bank lending flows to US monetary policy was driven mainly by increases in the sensitivities of individual banking systems, dominating the effects from a shift in the composition of international lending from less to more sensitive banking systems. Conversely, compositional changes were primarily responsible for the decline in the sensitivity of international bank lending to global risk conditions. National banking systems that were ex ante better capitalized experienced smaller increases in sensitivities to US monetary policy and larger increases in their market shares in international lending. Higher ex ante shares of deposits in total funding and local claims in foreign claims were also associated with larger increases in international lending market share. Certain prudential policy measures, such as local currency reserve requirements, were also associated with gains in the relative stability of international loan supply.

By utilizing a number of alternative perspectives made possible by the BIS international banking statistics, we show that the post-crisis evolution of the sensitivities of international

[22] Table C6 presents the contributions to regression explanatory power of the global versus local factors for AEs and EMs.

bank flows to global push factors appears to be driven by a combination of transitory drivers and others that are potentially more persistent. The increases in the sensitivities of individual banking systems to US monetary policy were largely driven by the convergence in advanced economy monetary policies that took place in the immediate aftermath of the GFC. As the monetary policies of advanced economies started to diverge in 2013, these transitory effects gradually weakened. By contrast, the effects related to the increased market shares of better-capitalized lending banking systems, which tend to be less responsive to fluctuations in global risk conditions, could turn out to be more persistent.

Overall, our analysis makes important contributions by investigating the dynamism in global liquidity drivers, as well as international monetary policy spillovers and risk effects. This dynamism, not previously explored in depth, is relevant for debates on the use and potential efficacy of capital controls, prudential instruments, and even the autonomous use of monetary policy. Regardless of the degree of integration with international financial markets, funding flows may be more responsive when policy cycles of advanced economies are more aligned. Funding flows through global banks appear to be less volatile for banks with greater capital buffers, more traditional funding models, and when global banks utilize local affiliates to a greater degree in their international lending. The results demonstrate that initiatives to make banking systems more robust in advanced countries, for example through prudential instrument changes and policies aimed at boosting capitalisation and stable funding levels, have had the positive side effect of reducing the amplitude of fluctuations in some forms of international capital flows to both advanced and emerging markets. Such policies complement the debates over borrower country macroprudential policies and capital flow management instruments. Open questions still remain around the behaviour of international debt securities, and await both richer data and more research on these financing flows.

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Table 1 – Typical Lenders and Borrowers

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

Table 2 – Locational baseline regressions (by borrowing country)

	Dependent variable: ΔCross-border loans †			Dependent variable: ΔInternational debt securities ‡		
Explanatory variables	All	to banks	to non-banks	All	by banks	by non-banks
ΔFed funds rate (1)	-1.95***	-2.48***	-1.86***	-1.76***	-2.26**	-1.44**
	(0.38)	(0.58)	(0.34)	(0.66)	(0.95)	(0.69)
Log(VIX)	-2.75***	-2.51***	-3.10***	-2.31***	-5.22***	-1.49*
	(0.59)	(0.96)	(0.62)	(0.75)	(1.77)	(0.83)
ΔReal GDP	0.54***	0.57***	0.50***	0.09	0.20	0.08
	(0.09)	(0.12)	(0.08)	(0.10)	(0.24)	(0.13)
ΔSovereign rating (2)	2.80***	4.37***	0.02	0.56	-1.50	0.30
	(1.06)	(1.40)	(0.84)	(0.85)	(2.82)	(1.05)
Chinn-Ito index (3)	-1.35	-3.03	0.30	8.11***	10.72**	4.87
	(1.79)	(2.87)	(1.85)	(2.89)	(4.61)	(3.03)
ΔReal global GDP	0.50***	0.81***	0.34**	0.00	-0.18	-0.15
	(0.16)	(0.24)	(0.16)	(0.26)	(0.79)	(0.30)
Observations	3,327	3,327	3,327	3,327	2,961	3,326
R-squared	0.11	0.07	0.08	0.05	0.03	0.03

Notes: The sample includes quarterly data 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. † to borrowers in country j. ‡ issued by borrowers in country j. (1) Effective federal funds rate for the period 2001:Q1 – 2008:Q4, Wu-Xia Shadow rate for the period 2009:Q1 – 2015:Q4. (2) Long term foreign currency sovereign rating, average across 3 agencies (S&P, Moody's and Fitch). (3) Measure of financial openness developed in Chinn and Ito (2008).

Table 3 - Locational baseline regressions (by borrowing country) with structural breaks

	Dependent variable: ΔCross-border loans †			Dependent variable: ΔInternational debt securities ‡			Dependent variable: ΔTotal cross-border flows (loans and debt securities)		
	All	to banks	to non-banks	All	by banks	by non-banks	All	to banks	to non-banks
Pre-break									
ΔFF (1)	-3.19***	-3.44***	-3.42***	-1.42	-1.26	-0.90	-2.07***	-2.57***	-2.09***
	(0.49)	(0.81)	(0.56)	(1.03)	(1.36)	(1.20)	(0.36)	(0.71)	(0.37)
VIX (2)	-3.94***	-4.43***	-4.36***	-1.09	-5.63**	-0.21	-3.11***	-4.09***	-2.70***
	(0.94)	(1.63)	(1.07)	(1.28)	(2.66)	(1.56)	(0.67)	(1.39)	(0.69)
Post-break - up to 2013:Q1									
ΔFF (1)	-8.07***	-10.79***	-6.16***	-8.17***	-20.23	-8.00***	-7.96***	-11.50***	-6.44***
	(1.336)	(2.088)	(1.188)	(2.510)	(12.75)	(2.542)	(1.00)	(1.96)	(0.93)
VIX (2)	-2.68**	-2.12	-2.87***	-3.07**	-5.60	-2.51*	-3.14***	-2.73*	-2.88***
	(1.071)	(1.671)	(1.063)	(1.476)	(5.225)	(1.517)	(0.83)	(1.61)	(0.79)
Post-break - up to 2015:Q4									
ΔFF (1)	-3.68***	-5.56***	-2.29***	-5.19***	-9.82***	-4.88***	-4.37***	-5.84***	-3.85***
	(0.71)	(1.02)	(0.72)	(0.92)	(3.79)	(0.93)	(0.47)	(0.84)	(0.49)
VIX (2)	-0.32	0.77	-0.99	-1.55	-1.25	-0.83	-1.18*	0.41	-1.13*
	(0.81)	(1.27)	(0.77)	(1.06)	(3.12)	(1.04)	(0.60)	(1.18)	(0.58)

Notes: The sample includes quarterly data 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. † to borrowers in country j. ‡ issued by borrowers in country j. (1) Effective federal funds rate for the period 2001:Q1 – 2008:Q4, Wu-Xia Shadow rate for the period 2009:Q1 – 2015:Q4. (2) Log(VIX). The regressions include ΔReal GDP, ΔSovereign Ratings, Chinn-Ito Index, ΔReal 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.

Table 4 – Convergence between loan and bond sensitivities

	Coefficients (XBL†) – Coefficients (IDS‡)		
Explanatory variables	All	to banks	to non-banks
Pre-break			
ΔFed funds rate (1)	-1.77*	-2.18*	-2.52**
	(1.14)	(1.58)	(1.32)
Log(VIX)	-2.85**	1.20	-4.14**
	(1.59)	(3.12)	(1.89)
Post-break			
ΔFed funds rate (1)	1.51	4.25	2.59**
	(1.16)	(3.92)	(1.18)
Log(VIX)	1.23	2.02	-0.15
	(1.33)	(3.37)	(1.29)

Notes: The sample includes quarterly data 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. † cross-border loans to borrowers in country j. ‡ international debt securities issued by borrowers in country j. (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 ΔReal GDP, ΔSovereign Ratings, Chinn-Ito Index, ΔReal Global GDP and a break dummy that takes value 1 after the break date (2009:Q1). The regressions also include a full set of country fixed effects.

Table 5 - Drivers of the shifts in lender-specific sensitivities

	Dependent variable: Structural change in the coefficient for ΔFed funds rate $\beta_1^{PostBreak} - \beta_1^{PreBreak}$			Dependent variable: Structural change in the coefficient for Log(VIX) $\beta_2^{PostBreak} - \beta_2^{PreBreak}$		
Explanatory variables	(I)	(II)	(III)	(IV)	(V)	(VI)
Pre-break Capital ratio (2008)	0.41**	0.31*	0.35*	0.53**	0.67***	0.46**
	(0.19)	(0.189)	(0.19)	(0.25)	(0.24)	(0.23)
Pre-break Average bank size (2008)	1.38***	1.46***	1.29**	-0.76	-0.82	-0.56
	(0.50)	(0.52)	(0.51)	(0.77)	(0.78)	(0.72)
Pre-break Prudential index (2008)	-0.47			0.57		
	(0.31)			(0.44)		
Pre-break LTV index (2008)		-1.27			-0.87	
		(0.80)			(1.089)	
Pre-break Local reserve requirement index (2008)			-0.83			3.30***
			(0.74)			(0.99)
Sectoral fixed effects	yes	yes	yes	yes	yes	yes
Observations	87	87	87	87	87	87
Q (1)	279.41	285.33	286.36	256.62	254.91	236.59
Degrees of Freedom test Q	81	81	81	81	81	81
I^2 (2)	0.71	0.72	0.72	0.69	0.68	0.66
τ^2 (3)	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

Note: Coefficients are obtained from the baseline model with structural breaks (equation (2)). This model is estimated for each of the available 29 lending countries (we excluded South Korea for which data are not available in the pre-break period) and for three different borrowers: banks, public sector and non-banks. We obtain therefore 29*3=87 observations. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1. (1) The Q Measure evaluates the level of homogeneity/heterogeneity among studies. It is calculated as the weighted squared difference of the estimated effects with respect to the mean. The statistical distribution of this measure follows a $\chi 2$ distribution. The null hypothesis of the test assumes homogeneity in the effect sizes. (2) This percentage represents the magnitude of the level of heterogeneity in effect sizes and it is defined as the percentage of the residual variation that it is attributable to between study heterogeneity. It is defined as the difference between the Q measure and the degrees of freedom divided by the Q measure. Although there can be no absolute rule for when heterogeneity becomes important, Harbord and Higgins (2008) tentatively suggest adjectives of low for I2 values between 25% and 50%, moderate for 50%-75% and high for values larger than 75%. (3) $\tau 2$ is a measure of population variability in effect sizes. It depends positively on the observed heterogeneity (Q measure) and its difference with respect to the degrees of freedom. The expected value of Q measure under the null hypothesis of homogeneity is equal to the degrees of freedom; a homogeneous set of studies will result in this statistic equal to zero. Under the presence of heterogeneity this estimate should be different from zero.

Table 6 - Drivers of the shifts in lender-specific weights

	Dependent variable: Change in the lending national banking system weights $w^{Postbreak} - w^{PreBreak}$			Dependent variable: Change in the lending national banking system weights $w^{Postbreak} - w^{PreBreak}$		
Explanatory variables	(I)	(II)	(III)	(IV)	(V)	(VI)
Pre-break Capital ratio (2008)	0.14*	0.12**	0.07*	0.21**	0.15**	0.09*
	(0.04)	(0.02)	(0.03)	(0.05)	(0.03)	(0.03)
Pre-break Average bank size (2008)	0.31	0.27	0.29	0.51	0.42	0.43
	(0.20)	(0.19)	(0.18)	(0.20)	(0.19)	(0.19)
Pre-break Prudential index (2008)	-0.10			-0.29**		
	(0.05)			(0.07)		
Pre-break LTV index (2008)		-0.13			-0.43*	
		(0.10)			(0.14)	
Pre-break Local reserve requirement index (2008)			0.45**			0.51**
			(0.08)			(0.10)
Pre-break Deposits to total assets ratio (2008)				0.04**	0.02**	0.01**
				(0.00)	(0.00)	(0.00)
Net interest income over total income (2008)				59.48*	32.23*	19.15*
				(19.54)	(17.56)	(10.70)
Local claims over Foreign claims (2008)				2.53*	2.86*	3.41**
				(0.81)	(0.83)	(0.78)
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

Note: The dependent variable is the difference in lending national banking system weights, expressed in percentage terms. Weights are available for 29 lending countries (we excluded South Korea for which data are not available in the pre-break period), while Local claims over Foreign claims are available for 25 countries (not for Chile, Hong Kong, Luxemburg and Mexico) and for three different borrowers: banks, public sector and non-banks. We obtain therefore 25*3=75 observations in the last three columns. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

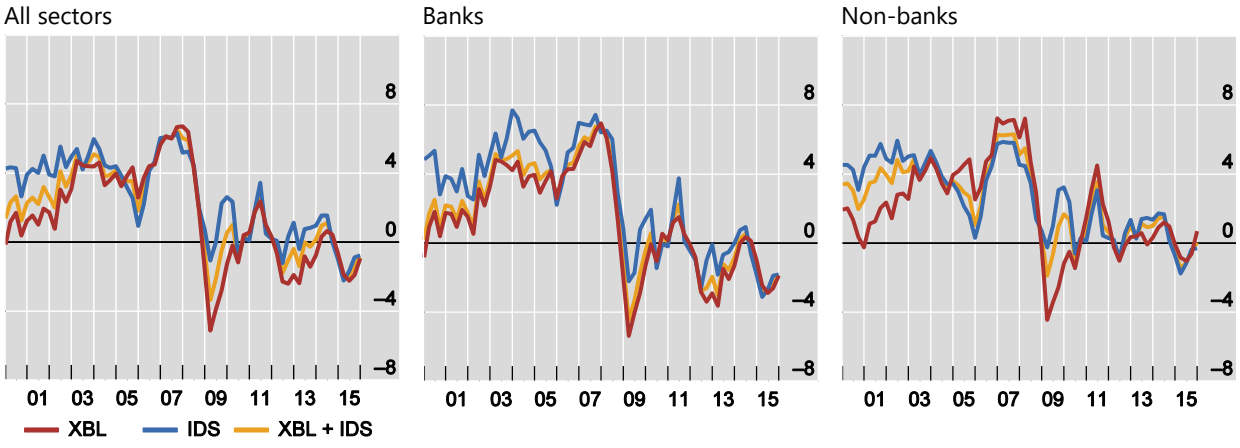
Table 7 Monetary Policy Divergence and Banking Net Interest Share in Time Varying Sensitivities

	Cross-border loans			International debt securities		
Explanatory variables	All	Banks	Non-banks	All	Banks	Non-banks
Post-break						
ΔFFR (1)	-8.41***	-11.19***	-7.16***	-7.16**	-23.63	-6.79**
	(1.99)	(2.94)	(1.94)	(3.245)	(15.95)	(3.20)
Log(VIX)	-4.78***	-4.04	-4.27***	-5.77**	-12.57**	-5.24*
	(1.45)	(2.47)	(1.31)	(2.64)	(5.60)	(2.72)
ΔFFR*NETINTtoTA (2)	-1.120	2.79	-3.24	8.30*	30.28*	7.62
	(3.39)	(4.73)	(3.15)	(4.78)	(15.51)	(4.92)
Log(VIX)*NETINTtoTA	1.24	2.27	-0.62	6.29	11.99	7.22
	(1.83)	(2.75)	(1.44)	(5.20)	(9.93)	(5.38)
ΔFFR*PolicyDivergence (3)	8.59***	7.30**	10.21***	0.389	4.09	0.76
	(2.54)	(3.26)	(2.65)	(3.02)	(9.46)	(3.12)
Log(VIX)*PolicyDivergence (3)	10.26***	10.95***	8.28***	3.46	14.97	3.34
	(2.40)	(3.88)	(2.36)	(3.189)	(9.39)	(3.27)
Other controls (4)						
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
Country FE	yes	yes	yes	yes	yes	yes

Notes: The sample includes quarterly data 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. † to borrowers in country j. ‡ issued by borrowers in country j. (1) Effective federal funds rate for the period 2001:Q1 – 2008:Q4, Wu-Xia Shadow rate for the period 2009:Q1 – 2015:Q4. (2) Net interest to total assets. (3) Difference between the 2-year futures on the policy rate for the United States and the average of the 2-year futures for the United Kingdom, Switzerland, Japan and a group of "core" Eurozone countries (Austria, Belgium, Germany, Finland, France, the Netherlands, Spain). (4) The regressions include ΔReal GDP, ΔSovereign Ratings, Chinn-Ito Index, ΔReal Global GDP. Please note that both pre-break and post-break coefficients enter independently and interacted with net interest to total assets and monetary policy divergence metrics. For the sake of brevity, only Post-Break coefficients are reported in the table. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

External debt flows, all borrowers

Four-quarter moving average of quarterly growth rates, in per cent — Graph 1

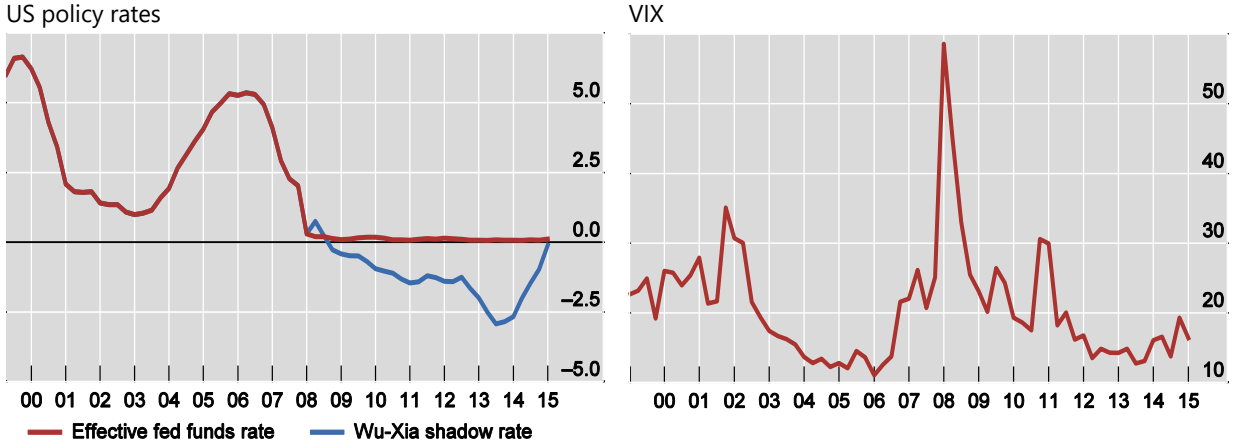


XBL = Cross-border loans: Quarterly Growth Rate$_t$ = (Outstanding Stock$_t$ / Outstanding Stock$_{t-1}$)-1; IDS = International Debt Securities: Quarterly Growth Rate$_t$ = (Outstanding Stock$_t$ / Outstanding Stock$_{t-1}$)-1.

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

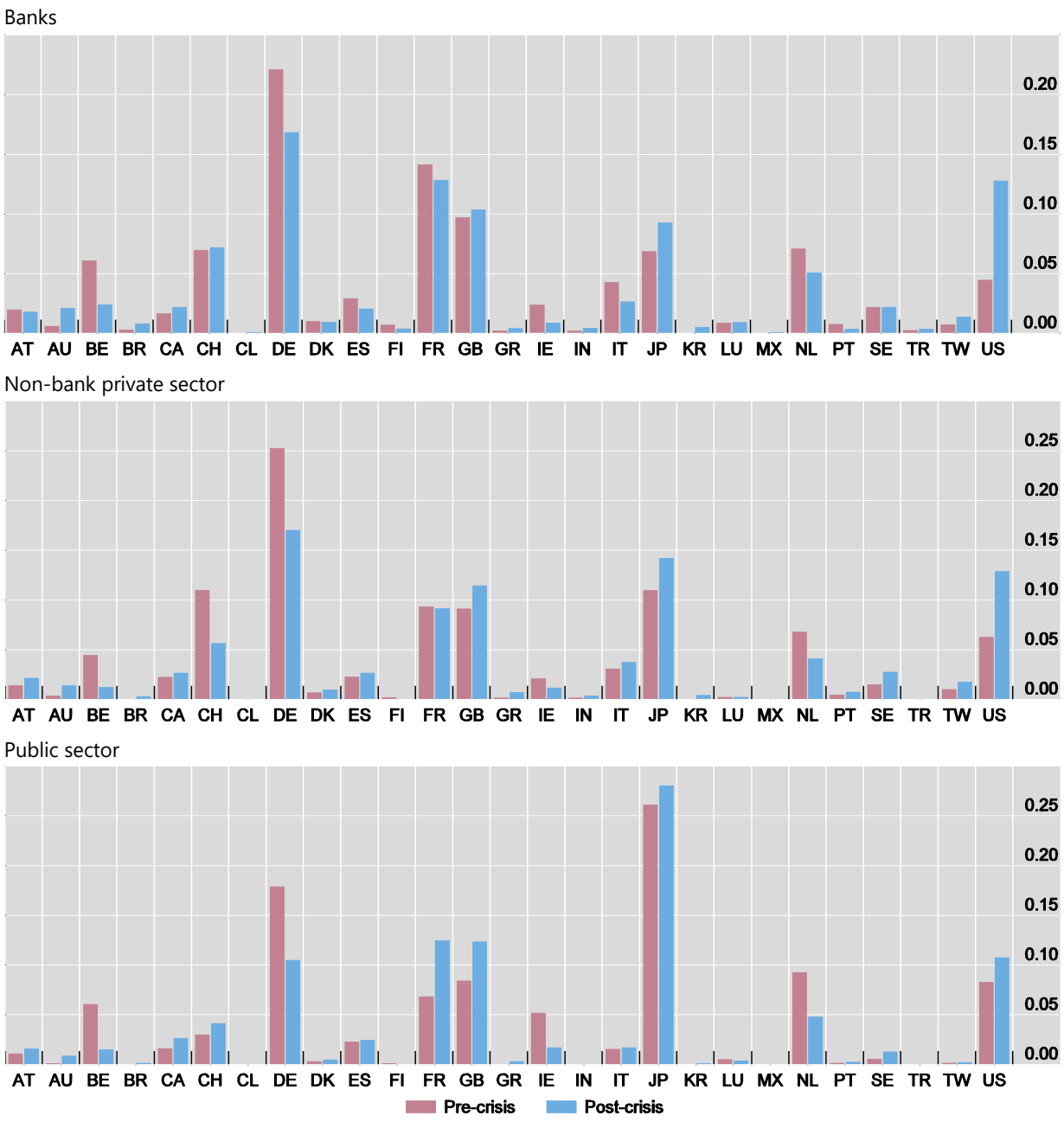
US policy rates and the VIX

Graph 2



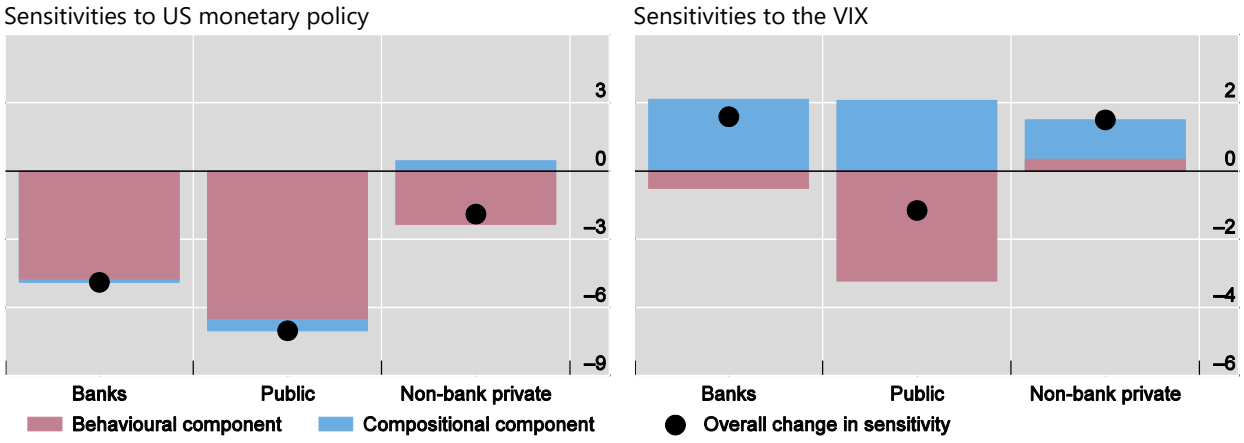
Sources: Wu and Xia (2015); Datastream.

Lending national banking system weights Graph 3



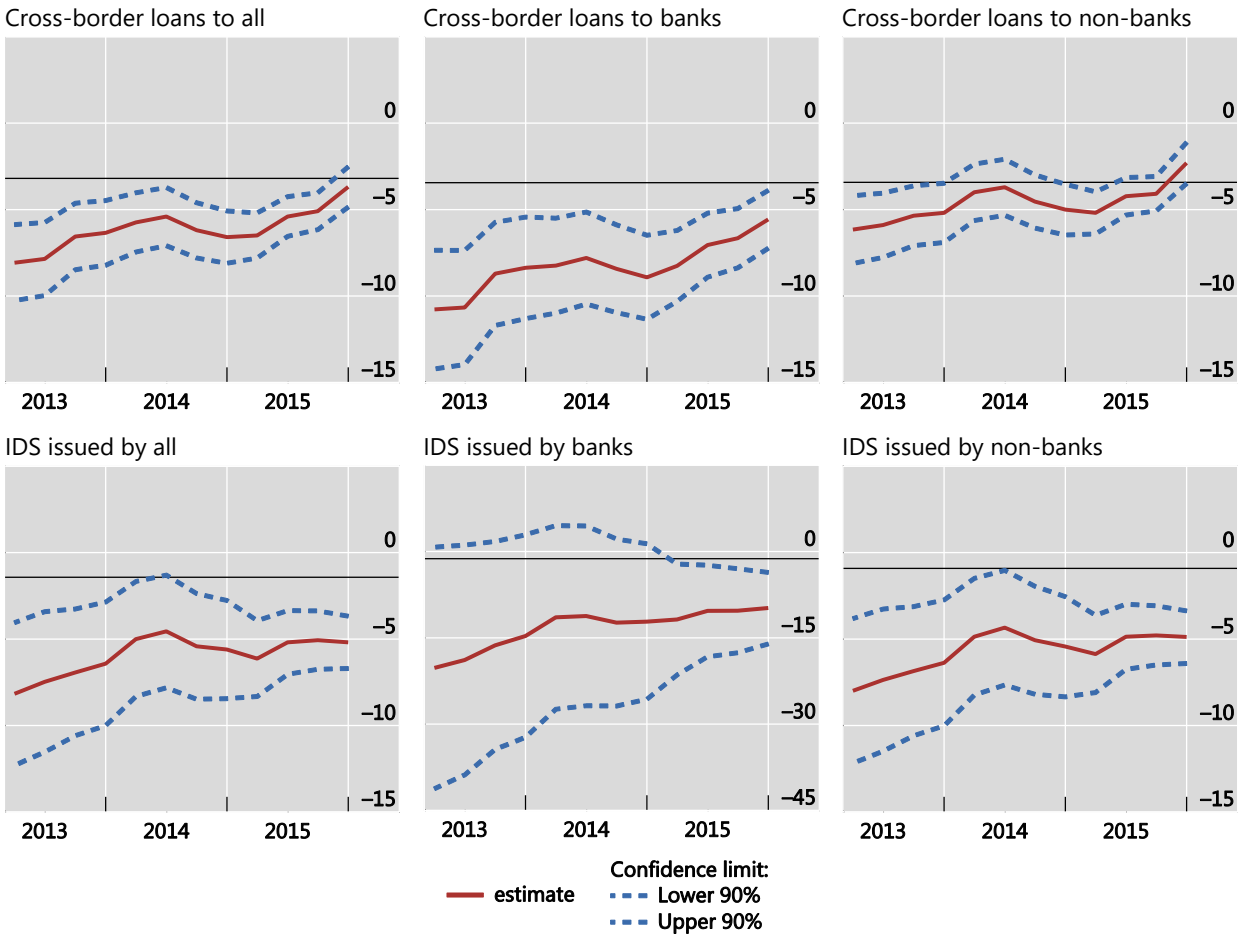
Sources: BIS consolidated banking statistics; authors' calculations.

Decomposing the shifts in lender-specific sensitivities, by borrowing sector Graph 4



Sources: BIS consolidated banking statistics; authors' calculations.

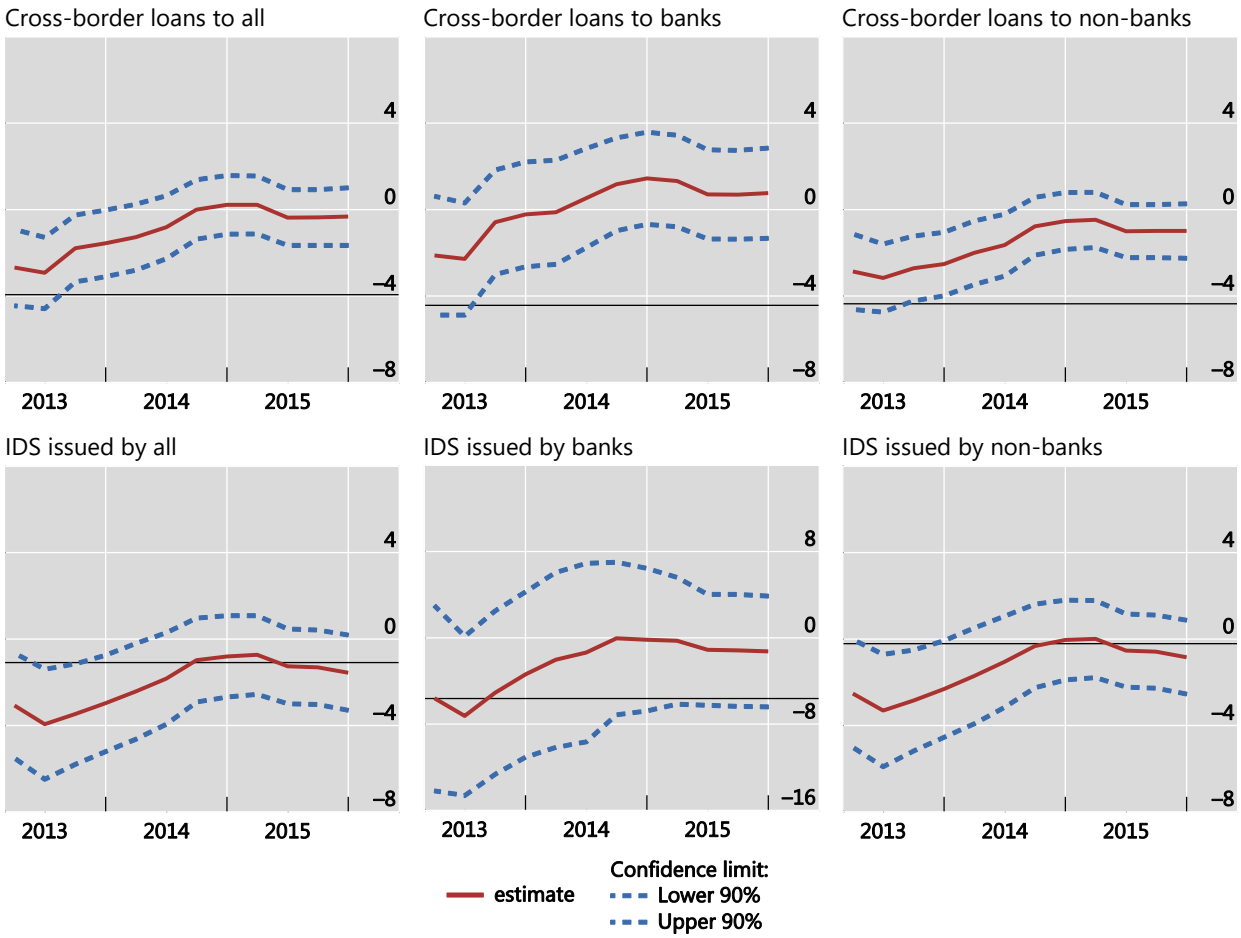
Post-break sensitivities to ΔFFR, evolution over time Graph 5



The graph shows the evolution over time of sensitivities to the ΔFFR. 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(VIX), ΔReal GDP, ΔSovereign Ratings, Chinn-Ito Index, ΔReal Global GDP, ΔFFR (i.e. ΔEffective federal funds rate for the period 2001:Q1 – 2008:Q4, ΔWu-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 ΔFFR.

Sources: authors' calculations.

Post-break sensitivities to log(VIX), evolution over time Graph 6



The graph shows the evolution over time of sensitivities to the log(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(VIX), ΔReal GDP, ΔSovereign Ratings, Chinn-Ito Index, ΔReal Global GDP, ΔFFR (i.e. ΔEffective federal funds rate for the period 2001:Q1 – 2008:Q4, ΔWu-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(VIX).

Sources: authors' calculations.

Annex A: Decomposing the post-crisis shifts in sensitivities, detailed derivations

We start our derivation by re-writing specification (1) as:

$$\frac{S_t^j}{S_{t-1}^j} - 1 = \beta_1 \Delta FFR_t + \beta_2 logVIX_t + \beta_3 \Delta logGDP_t^j + \beta_4 \Delta SovRating_t^j + \beta_5 ChinnIto_t^j + \beta_6 \Delta logGlobalGDP_t + \mu^j + \varepsilon_t^j$$

Where S_t^j is the outstanding stock of international bank lending to the residents of country *j* at the end of period *t*. Defining $S_t^{i,j}$ as the outstanding stock of international lending by banks from country *i* to the residents of country *j* at the end of period *t*, we can write the national banking system-specific counterpart to specification (1) as:

$$\frac{S_t^{i,j}}{S_{t-1}^{i,j}} - 1 = \beta_1^i \Delta FFR_t + \beta_2^i logVIX_t + \beta_3^i \Delta logGDP_t^j + \beta_4^i \Delta SovRating_t^j + \beta_5^i ChinnIto_t^j + \beta_6^i \Delta logGlobalGDP_t + \mu^{i,j} + \varepsilon_t^{i,j} \quad \text{(A1)}$$

$$\frac{S_t^j}{S_{t-1}^j} - 1 = \frac{\sum_i S_t^{i,j}}{\sum_i S_{t-1}^{i,j}} - 1 = \sum_i \left(\frac{S_t^{i,j}}{S_{t-1}^{i,j}} * \frac{S_{t-1}^{i,j}}{\sum_i S_{t-1}^{i,j}} \right) - 1 =$$

Setting $w_{t-1}^{i,j} = \frac{S_{t-1}^{i,j}}{\sum_i S_{t-1}^{i,j}}$, we have:

$$\frac{S_t^j}{S_{t-1}^j} - 1 = \sum_i \left(\frac{S_t^{i,j}}{S_{t-1}^{i,j}} * w_{t-1}^{i,j} \right) - 1$$

Since $\sum_i (w_{t-1}^{i,j}) = 1$, we can write:

$$\frac{S_t^j}{S_{t-1}^j} - 1 = \sum_i \left(\frac{S_t^{i,j}}{S_{t-1}^{i,j}} * w_{t-1}^{i.j} \right) - \sum_i (w_{t-1}^{i,j})$$

$$\frac{S_t^j}{S_{t-1}^j} - 1 = \sum_i \left\{ \left(\frac{S_t^{i,j}}{S_{t-1}^{i,j}} - 1 \right) w_{t-1}^{i,j} \right\} \quad \text{(A2)}$$

Inserting (A1) into the right-hand side of (A2), we get:

$$\frac{S_t^j}{S_{t-1}^j} - 1 = \sum_i \{ (\beta_1^i \Delta FFR_t + \beta_2^i logVIX_t + \beta_3^i \Delta logGDP_t^j + \beta_4^i \Delta SovRating_t^j + \beta_5^i ChinnIto_t^j + \beta_6^i \Delta logGlobalGDP_t + \mu^{i,j} + \varepsilon_t^{i,j}) w_{t-1}^{i,j} \}$$

Replacing the left-hand side of (1) with the right-hand side of (1) in the above expression, we obtain:

$$\beta_1 \Delta FFR_t + \beta_2 logVIX_t + \beta_3 \Delta logGDP_t^j + \beta_4 \Delta SovRating_t^j + \beta_5 ChinnIto_t^j + \beta_6 \Delta logGlobalGDP_t + \mu^j + \varepsilon_t^j = \sum_i \{ (\beta_1^i \Delta FFR_t + \beta_2^i logVIX_t + \beta_3^i \Delta logGDP_t^j + \beta_4^i \Delta SovRating_t^j + \beta_5^i ChinnIto_t^j + \beta_6^i \Delta logGlobalGDP_t + \mu^{i,j} + \varepsilon_t^{i,j}) w_{t-1}^{i,j} \}$$

Matching the coefficient on the global factors, we obtain the following expressions:

$$\beta_1 = \sum_i \{\beta_1^i w_{t-1}^{i,j}\}$$
$$\beta_2 = \sum_i \{\beta_2^i w_{t-1}^{i,j}\}$$

The (pre-crisis versus post-crisis) changes in the sensitivities to the federal funds rate and the VIX can be expressed as:

$$\begin{aligned}\beta_{1,post} - \beta_{1,pre} &= \sum_i \{\beta_{1,post}^i w_{post}^i\} - \sum_i \{\beta_{1,pre}^i w_{pre}^i\} = \sum_i \{\beta_{1,post}^i w_{post}^i - \beta_{1,pre}^i w_{pre}^i\} \\ &= \sum_i \{(\beta_{1,post}^i - \beta_{1,pre}^i) w_{pre}^i + (w_{post}^i - w_{pre}^i) \beta_{1,post}^i\}\end{aligned} \tag{A3}$$

$$\begin{aligned}\beta_{2,post} - \beta_{2,pre} &= \sum_i \{\beta_{2,post}^i w_{post}^i\} - \sum_i \{\beta_{2,pre}^i w_{pre}^i\} = \sum_i \{\beta_{2,post}^i w_{post}^i - \beta_{2,pre}^i w_{pre}^i\} \\ &= \sum_i \{(\beta_{2,post}^i - \beta_{2,pre}^i) w_{pre}^i + (w_{post}^i - w_{pre}^i) \beta_{2,post}^i\}\end{aligned} \tag{A4}$$

Annex B: Country lists

Borrowing countries (64)

Argentina (AR), Australia (AU), Austria (AT), Belgium (BE), Brazil (BR), Bulgaria (BG), Canada (CA), Chile (CL), China (CN), Colombia (CO), Croatia (HR), Czech Republic (CZ), Denmark (DK), Estonia (EE), Finland (FI), France (FR), Germany (DE), Greece (GR), Hong Kong SAR (HK), Hungary (HU), Iceland (IS), India (IN), Indonesia (ID), Ireland (IE), Israel (IL), Italy (IT), Japan (JP), Korea (KR), Kuwait (KW), Latvia (LV), Lebanon (LB), Lithuania (LT), Luxembourg (LU), Malaysia (MY), Malta (MT), Mexico (MX), Mongolia (MN), Netherlands (NL), New Zealand (NZ), Nigeria (NG), Norway (NO), Peru (PE), Philippines (PH), Poland (PL), Portugal (PT), Romania (RO), Russia (RU), Saudi Arabia (SA), Serbia (RS), Singapore (SG), Slovakia (SK), Slovenia (SI), South Africa (ZA), Spain (ES), Sweden (SE), Switzerland (CH), Taiwan (TW), Thailand (TH), Turkey (TR), Ukraine (UA), United Kingdom (GB), United States (US), Uruguay (UY), Vietnam (VN).

CBS lending bank nationalities (31)

Australia (AU), Austria (AT), Belgium (BE), Brazil (BR), Canada (CA), Chile (CL), Denmark (DK), Finland (FI), France (FR), Germany (DE), Greece (GR), Hong Kong SAR (HK), India (IN), Ireland (IE), Italy (IT), Japan (JP), Korea (KR), Luxembourg (LU), Mexico (MX), Netherlands (NL), Norway (NO), Panama (PA), Portugal (PT), Singapore (SG), Spain (ES), Sweden (SE), Switzerland (CH), Taiwan (TW), Turkey (TR), United Kingdom (GB), United States (US).

Annex C: Additional tables and graphs

Table C1 - Descriptive statistics of the explanatory variables

Variables	Obs.	Mean	Std. Dev.	Min	Max
Global factors					
ΔFed fund rates (1)	4,069	-0.08	0.52	-1.73	1.00
Log (VIX)	4,069	2.97	0.34	2.40	4.07
ΔGlobal GDP	4,069	3.66	1.67	-2.49	5.75
Country-specific variables					
ΔGDP	3,658	3.15	3.91	-19.30	28.10
ΔSovereign 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
Prudential tools (4)					
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
Lenders' balance sheet characteristics					
Pre-break capital ratio (13)	30	0.08	0.04	0.04	0.24
Pre-break average bank size (13)	30	14.92	1.14	12.84	17.01
Pre-break deposits to total assets (13)	30	0.75	0.10	0.53	0.94
Net interest income to total assets (14)	4,069	0.63	0.50	-3.81	2.96
Monetary policy divergence proxy					
Spread on 2-year futures on the policy rate (15)	4,069	1.05	0.76	0.01	3.00

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) Long term foreign currency sovereign rating, average across 3 agencies (S&P, Moody's and Fitch). (3) Measure of financial openness developed in Chinn and Ito (2008). (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. (13) These aggregate balance sheet characteristics of the banking sector pertain to the 30 lending countries in our sample. They refer to the end of the year 2008, right before the structural break in our model. (14) This variable is borrower-specific and is computed as the weighted average for all countries lending to a specific borrower. (15) Difference between 2-year futures contract on the US policy rate and the simple average of similar futures contracts for other advanced economies (CH, EUR, JP, UK).

Table C2 – Locational baseline regressions (by borrowing country) with alternative shadow rates

	Dependent variable: ΔCross-border loans †			Dependent variable: ΔInternational debt securities ‡		
Explanatory variables	All	to banks	to non-banks	All	by banks	by non-banks
ΔKrippner (1)	-1.12***	-0.77**	-1.21***	-0.81	-1.72**	-0.73
	(0.27)	(0.39)	(0.29)	(0.54)	(0.84)	(0.54)
Log(VIX)	-3.87***	-2.88**	-4.29***	-2.85***	-7.47***	-2.09**
	(0.71)	(1.16)	(0.78)	(0.99)	(2.53)	(0.97)
ΔReal GDP	0.57***	0.61***	0.53***	0.17*	0.23	0.17
	(0.07)	(0.12)	(0.07)	(0.09)	(0.27)	(0.13)
ΔSovereign rating (2)	2.11**	3.54**	-0.67	1.09	-1.94	0.86
	(1.01)	(1.38)	(0.72)	(0.76)	(3.03)	(0.96)
Chinn-Ito index (3)	-0.59	-1.89	1.08	8.43***	12.32**	5.03
	(1.83)	(2.95)	(1.86)	(2.99)	(4.83)	(3.13)
ΔReal global GDP	0.212	0.51**	0.09	-0.28	-0.57	-0.43
	(0.15)	(0.24)	(0.14)	(0.24)	(0.83)	(0.28)
Observations	3,115	3,115	3,115	3,115	2,765	3,114
R-squared	0.11	0.08	0.07	0.06	0.03	0.04
ΔBauer-Rudebusch (4)	-1.78***	-1.84***	-1.99***	-2.04**	-0.24	-1.78***
	(0.44)	(0.64)	(0.49)	(1.00)	(1.54)	(0.44)
Log(VIX)	-3.33***	-2.99***	-3.77***	-3.04***	-4.72**	-3.34***
	(0.63)	(1.04)	(0.68)	(0.78)	(2.14)	(0.63)
ΔReal GDP	0.58***	0.61***	0.53***	0.17*	0.23	0.57***
	(0.07)	(0.11)	(0.07)	(0.09)	(0.27)	(0.07)
ΔSovereign rating (2)	2.18**	3.65***	-0.59	1.21	-2.03	2.18**
	(1.00)	(1.37)	(0.74)	(0.77)	(3.01)	(1.00)
Chinn-Ito index (3)	-0.61	-1.95	1.05	8.35***	12.40**	-0.61
	(1.82)	(2.94)	(1.86)	(2.97)	(4.86)	(1.83)
ΔReal global GDP	0.33**	0.59**	0.21	-0.20	-0.39	0.33**
	(0.15)	(0.23)	(0.14)	(0.26)	(0.80)	(0.15)
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 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. † to borrowers in country j. ‡ issued by borrowers in country j. (1) Estimate of the Fed fund shadow rate based on Krippner (2014). (2) Long term foreign currency sovereign rating, average across 3 agencies (S&P, Moody's and Fitch). (3) Measure of financial openness developed in Chinn and Ito (2008). (4) Measure of the Fed fund shadow rate based on Bauer and Rudebusch (2016).

Table C3 - Baseline model with 2-year US rates instead of shadow rates

	Dependent variable: ΔCross-border loans †			Dependent variable: ΔInternational debt securities ‡		
Explanatory variables	All	to banks	to non-banks	All	by banks	by non-banks
ΔFed funds rate (1)	-1.62***	-0.95	-2.41***	-0.14	-0.18	-0.16
	(0.49)	(0.77)	(0.53)	(1.16)	(1.50)	(1.28)
Log(VIX)	-2.62***	-1.46	-3.66***	-1.25	-3.84*	-0.73
	(0.68)	(1.12)	(0.73)	(0.89)	(2.14)	(0.97)
ΔReal GDP	0.53***	0.60***	0.47***	0.10	0.19	0.095
	(0.08)	(0.12)	(0.08)	(0.10)	(0.23)	(0.19)
ΔSovereign rating (2)	2.70	4.18***	0.06	0.49	-1.35	0.20
	(1.05)	(1.39)	(0.83)	(0.84)	(2.77)	(1.03)
Chinn-Ito index (3)	-1.74	-3.69	0.28	7.90***	9.94**	4.83
	(1.84)	(2.99)	(1.84)	(3.00)	(4.81)	(3.14)
ΔReal global GDP	0.37**	0.62***	0.25	-0.06	-0.18	-0.23
	(0.16)	(0.23)	(0.15)	(0.23)	(0.74)	(0.27)
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 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. † to borrowers in country j. ‡ issued by borrowers in country j. (1) Two-year Treasury rate. (2) Long term foreign currency sovereign rating, average across 3 agencies (S&P, Moody's and Fitch). (3) Measure of financial openness developed in Chinn and Ito (2008).

Table C4 – Baseline model with alternative measures of portfolio debt flows

	Dependent variable: ΔPortfolio debt flows †		
Explanatory variables	All	by banks	by non-banks
ΔFed funds rate (1)	-1.69***	-1.81***	-1.85***
	(0.26)	(0.50)	(0.27)
Log(VIX)	-3.08***	-4.96***	-2.56***
	(0.44)	(0.83)	(0.46)
ΔReal GDP	0.04	0.10	0.03
	(0.04)	(0.08)	(0.05)
ΔSovereign rating (2)	1.10***	2.91***	0.48
	(0.40)	(0.82)	(0.56)
Chinn-Ito index (3)	3.17**	4.81*	-0.31
	(1.31)	(2.88)	(1.31)
ΔReal global GDP	0.058	0.26	-0.01
	(0.09)	(0.18)	(0.102)
Observations	2,592	2,447	2,592
R-squared	0.07	0.07	0.05

Notes: The sample includes quarterly data 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. † 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. (2) LT foreign currency, average across 3 agencies. (3) Measure of financial openness developed in Chinn and Ito (2008).

Table C5 – Disentangling the effects in advanced and emerging market economies with different post-break periods

	Dependent variable: ΔCross-border loans †		Dependent variable: ΔInternational debt securities ‡	
Explanatory variables	Advanced economies	Emerging economies	Advanced economies	Emerging economies
Pre-break				
ΔFed funds rate (1)	-2.18***	-4.67***	-2.56	-0.62
	(0.66)	(0.73)	(1.88)	(0.73)
Log(VIX)	-3.98***	-4.33***	1.01	-3.92***
	(1.23)	(1.43)	(2.11)	(1.27)
Post-break (up to 2013:Q1)				
ΔFed funds rate (1)	-8.01***	-7.42***	-13.54***	-5.62***
	(1.86)	(1.78)	(4.55)	(1.86)
Log(VIX)	-2.51*	-3.29**	-0.09	-3.04*
	(1.41)	(1.56)	(2.27)	(1.84)
Post-break (up to 2015:Q4)				
ΔFed funds rate (1)	-3.51***	-2.98***	-6.80***	-4.06***
	(0.93)	(1.14)	(1.57)	(1.10)
Log(VIX)	-1.15	-0.90	0.46	-2.68**
	(1.12)	(1.07)	(1.70)	(1.27)

Notes: The sample includes quarterly data for 64 recipient countries (29 advanced economies and 35 emerging economies) 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. † to borrowers in country j. ‡ issued by borrowers in country j. (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 ΔReal GDP, ΔSovereign Ratings, Chinn-Ito Index, ΔReal Global GDP and a break dummy that takes value 1 after the break date (2009:Q1). The regressions also include a full set of country fixed effects.

Table C6 – R squared decompositions - Locational baseline regressions (by borrowing country) with structural breaks

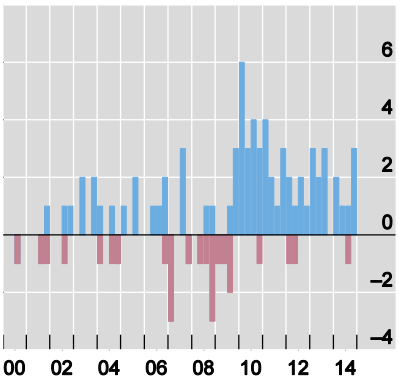
Region	Variables	Dependent variable: ΔCross-border loans †			Dependent variable: ΔInternational debt securities ‡		
		All	to banks	to non-banks	All	by banks	by non-banks
All countries	***Pre-break***						
	Global	54.63	51.09	60.34	65.02	51.22	70.04
	Local	45.37	48.91	39.66	34.98	48.78	29.96
	Post-break						
	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
	Total global	51.35	51.75	56.06	60.09	68.87	67.19
	Total local	48.66	48.25	43.94	39.91	31.13	32.81
AEs	***Pre-break***						
	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
	Post-break						
	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
	Total global	40.99	34.56	48.10	48.01	31.81	52.93
	Total local	59.01	65.44	51.90	51.99	68.19	47.07
EMEs	***Pre-break***						
	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
	Post-break						
	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
	Total global	52.48	58.58	50.57	78.00	87.45	66.69
	Total local	47.52	41.42	49.43	22.00	12.55	33.31

Notes: The table contains the Shapley values calculated following the methodology developed in Huettner and Sunder (2012). This measure is represented as a percentage of the overall R-squared explained by global and local variables for various types of cross-border flow pre and post-crisis. Shapley value adds the marginal contribution to the R-squared form adding regressor x_k to the model, weighted by the number of permutations represented by this submodel. The R^2 refers to a regression of one type of cross-border 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), ΔReal Global GDP and ΔFFR (i.e. ΔEffective federal funds rate for the period 2001:Q1 – 2008:Q4, ΔWu-Xia Shadow rate for the period 2009:Q1 – 2015:Q4). Local variables include ΔReal GDP, ΔSovereign Ratings, the Chinn-Ito measure of financial openness. The model includes a structural break in 2009:Q1. The sample includes quarterly data for 64 recipient countries (29 advanced economies and 35 emerging economies) over the period 2000:Q1 - 2015:Q4.

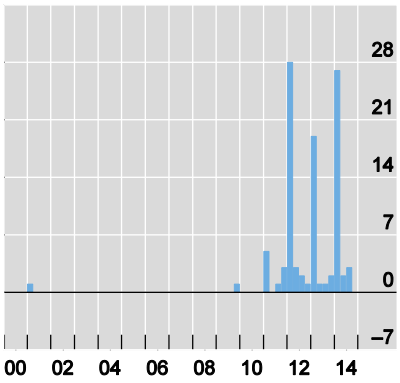
Changes in prudential policies

Graph C1

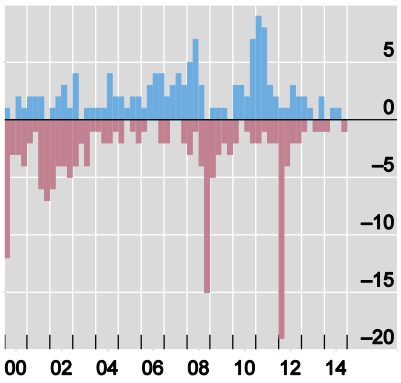
Loan to value ratio limits



General capital requirements



Reserve requirements (local)



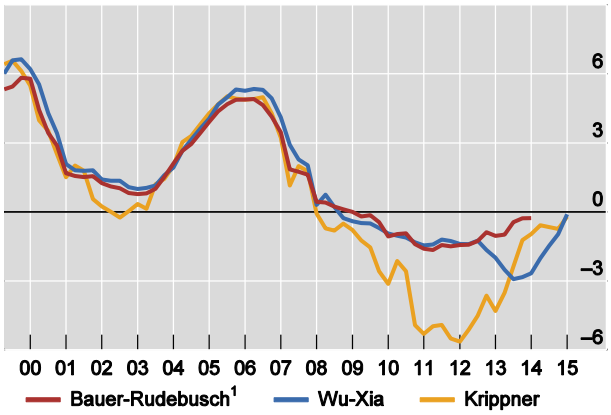
Sources: IBRN Prudential Instruments Database, Cerutti et al. (2017).

Shadow rates

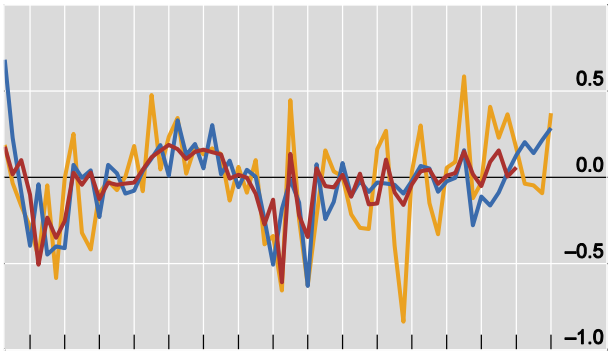
In per cent

Graph C2

Levels



Changes



[1] Median of 12 shadow rate estimates.

Sources: Datastream; Bauer and Rudebusch (2016); Krippner (2014); Wu and Xia (2016).