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IMF POLICY PAPER

March 11, 2014

GLOBAL LIQUIDITY—ISSUES FOR SURVEILLANCE

IMF staff regularly produces papers proposing new IMF policies, exploring options for reform, or reviewing existing IMF policies and operations. The following document(s) have been released and are included in this package:

The **Staff Report** on Global Liquidity—Issues for Surveillance, was prepared by IMF staff and completed on March 11, 2014 to brief the Executive Board on March 19, 2014.

The Executive Directors met in an informal session, and no decisions were taken at this meeting.

International Monetary Fund
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GLOBAL LIQUIDITY—ISSUES FOR SURVEILLANCE

EXECUTIVE SUMMARY

Context. The global financial crisis and associated policy interventions have highlighted the transmission of financial shocks in an interconnected global economy. In this context, the concept of global liquidity has been loosely used to discuss developments. The Fund membership has called on staff to analyze these issues and propose a systematic framework to monitor global liquidity for the benefit of Fund's surveillance.

Concept. Much work remains to be done to develop an adequate theoretical framework for analyzing global liquidity. This paper therefore defines global liquidity operationally as the factors that drive the supply of funding from international financial centers and thereby affect the ease of global financing. These factors include the nature and composition of investors, financial innovation, general risk appetite, balance sheets of global financial and nonfinancial entities, and policy settings in key economies, including prudential and financial regulation and monetary policy.

Analytics. The paper starts by presenting evidence of commonality in global financial conditions. This commonality is then related to specific drivers of global financial conditions through a range of transmission channels, including cross-border banking and portfolio flows. Empirical analysis shows a range of price and quantity factors, including measures of risk, bank leverage, and interest rates in financial centers, to drive in part these flows. Country specific policies, including exchange rate and prudential frameworks, are shown to affect the transmission of global conditions. Much remains unknown though, including how evolving structures of global funding, changing institutions, and ongoing financial innovations affect the mechanics of liquidity creation, the channels of liquidity transmission, and potential risks going forward.

Surveillance. Drawing on analytics and based on their expected impact on macro-financial conditions and stability across countries, the paper suggests indicators across various types of economies for tracking global liquidity. For monitoring purposes these are organized into a dashboard tracing their trends over time. The dashboard tracks well the evolution of global financial conditions, with several of these indicators already monitored in flagship multilateral surveillance products.

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MOTIVATION AND SCOPE

1. **Goal**. Against the background of a debate on the influence of major central banks' policies on international financial developments, the Saint-Petersburg G20 Summit in September 2013 called on the IMF "*to carry out further research with a view to develop proposals on how to incorporate global liquidity indicators more broadly into the Fund's surveillance work*." This paper provides an operational framework for thinking about global financial conditions and global liquidity, presents stylized facts on cross-border flows, and analyzes indicators of relevance for surveillance that may help assess global financial conditions and their transmissions. Global liquidity has been discussed previously by the IMF (2010, 2013b) and the CGFS (2011), its dynamics have been explored in recent work,[1] and the BIS has started monitoring a selection of indicators, including price, flow, and stock measures, in semi-annual updates. This paper builds on these efforts.

2. **Concept of global liquidity**. The global financial crisis and the associated large scale policy interventions around the world have raised many questions about the transmission of financial shocks in an interconnected global economy. Concepts such as global liquidity have been used in discussing these questions, but not always clearly, in part because the term "liquidity" has many meanings (Box 1). Yet the expression "global liquidity" is commonly used to refer to the "ease of funding" in global financial markets. It is manifest in the extent to which borrowing constraints are binding in accessing international funding and can be captured in how conditions in financial centers – systemic, reserve currency economies – are transmitted to other financially open economies through capital flows. As it is often identified both with conditions prevailing in major financial markets and intermediaries, and monetary policy conditions, it lies at the intersection of microeconomic, financial, regulatory and macroeconomic factors.

Box 1. Liquidity in the Small and in the Large

The term "liquidity" has been used to designate many concepts in economic and financial theory. *Micro-founded notions* encompass cash holdings by individual agents (e.g. consumers, firms), or their ability to obtain cash by selling assets or funding by pledging collateral. *Market liquidity* refers to the ease with which assets can be bought and sold at approximately the same price, which is largely determined by market-making activities, and can be measured by bid-ask spreads and price resilience. Market liquidity is one determinant of funding liquidity. From a financial intermediation perspective, *funding liquidity* generally refers to the availability of (whole-sale) funds for banks, along with the ease of intermediation through off-balance sheet vehicles and non-bank financial institutions ("shadow banking"). S*tatistical* measures of financial intermediation include "liquidity transformation". In a *macroeconomic framework*, the concept of liquidity encompasses various definitions of money aggregates, the availability of credit and funding within the overall economy, the capacity of a country or its residents to access international funding, and their holdings of internationally liquid assets (e.g., official foreign exchange reserves, and foreign currency liquidity, taking into account predetermined and contingent drains on reserves).

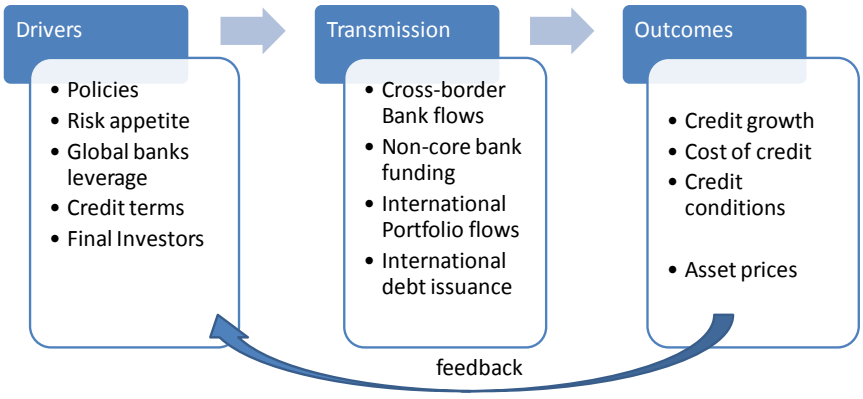
[1] See a variety of working papers from the IMF (González-Hermosillo, 2008, Matsumoto, 2011, Chen et al., 2012, Chung et al., 2014, Cerutti et al., 2014) and BIS (Eickmeier et al. 2013, He and McCauley, 2013).

3. Framework. Consistent with this conceptualization of global liquidity, one can distinguish between drivers, transmission channels, and financial conditions outcomes. In this framing, ease of *global* finance is *driven* by conditions prevailing in major financial markets, is *transmitted* internationally by globally operating financial intermediaries and activities in international financial markets, and together with country-specific factors, leads to *local* financial conditions *outcomes*.

- ***Global drivers***. Financial conditions result from actions by the public and private sectors, interacting with each other, in a given macroeconomic context, and within institutional, legal and regulatory frameworks. For example, the creation of private liquidity in response to monetary policy actions will depend on the state of the economy, financial regulation, and financial-sector size and structure; and will be influenced by financial innovation in the private sector. In general, global drivers can be classified as prices (such as key policy rates, international money market and benchmark bond market rates), non-price factors (such as investors' risk appetite, financial innovation, leverage), and constraints faced by lenders and investors in major financial markets (including credit limits, margin requirements).

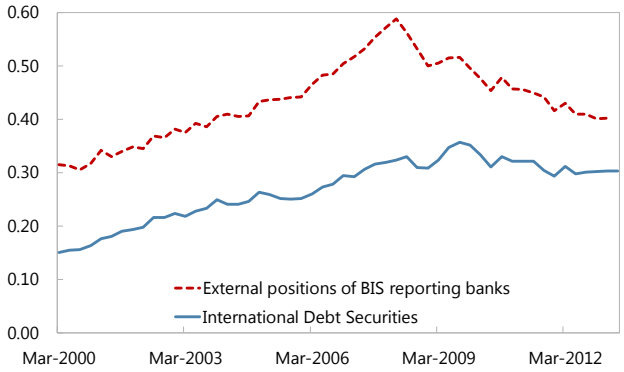
- ***Transmission.*** Liquidity is transmitted internationally, depending on the incentives facing internationally operating financial intermediaries and investors (including arbitrage opportunities), and global market structures, with many of these factors feeding back into one another and varying over the cycle. In particular, conditions are transmitted through (i) operations of globally active financial intermediaries (i.e., G-SIFIs), and (ii) transactions in international capital markets (e.g., investments in local stock and bond markets), and are manifested in the form of cross-border bank, portfolio flows, and asset price co-movements. Such flows allow wholesale (or non-core) external funding, and international debt issuance and equity placements by financial intermediaries and firms in local economies.

- ***Local outcomes***. Domestic financial conditions include the level, cost and availability of credit to the private sector, and relative levels of asset prices. Credit conditions (including, besides cost, others terms such as collateral and loan-to-value ratio requirements) and asset prices themselves are determined inter alia by the domestic monetary stance, prudential policy settings, and other financial sector conditions, including leverage, as well as by external factors, including global liquidity.



4. **Relevance**. As international financial conditions affect domestic economic and financial conditions — depending on the extent of financial integration — through various channels they can give rise to both benefits and risks. Global cyclical swings can add a welcome impetus and support local activity during times of stress. But they can also have undesirable procyclical effects:

International Banking and International Debt Securities
Outstanding - Ratio to World GDP



Sources: BIS tables 6a and 11a, and WEO

- In the face of global pressures, domestic monetary and fiscal policies can become less effective.
- Depending on the use and effectiveness of macroeconomic and prudential policy responses, favorable global financial conditions can add to the build-up of vulnerabilities (e.g. asset price booms and related financial fragilities, possibly leading to busts and resulting in instability).
- Given the significant increase in financial integration through cross-border banking and debt placement (Text Chart), international financial stability may also be directly at stake, as when globally systemic financial institutions become more vulnerable to liquidity shocks, with important possible feedback effects on the real economy.

Monitoring liquidity, funding, and credit conditions globally is therefore important for both bilateral and multilateral surveillance, and can help integrate them. And there can be a need to adapt policy responses, both domestically and globally, with implications for Fund advice.

5. **Indicators.** The state of the art in understanding global liquidity is however still limited, both regarding the channels through which financial conditions affect global investors' risk-taking, capital flows and ensuing vulnerabilities, and in determining how global liquidity is consequently best measured. A better understanding of the policy drivers of liquidity conditions in advanced economies, and the mechanisms of international propagation and related amplification of financial shocks is sorely needed. In the meantime, the challenge for surveillance is to find empirically useful indicators that have sound conceptual underpinnings. Multiple indicators corresponding to various aspects of liquidity have been proposed over time — in particular by the BIS and in previous IMF staff work — and found to be useful in detecting vulnerabilities. Yet continuously changing institutional environments, evolving micro- and macro-prudential and other regulatory policies, ongoing financial innovations and shifting market structures, all keep reshaping the mechanics of liquidity creation and propagation. This reinforces a key lesson from earlier crisis episodes that a continuous review of indicators is warranted.

WHAT IS GLOBAL LIQUIDITY?

Recent evidence has highlighted the international cyclicality of financial conditions, including through global common trends. Given the incomplete state of the literature, this section provides an operational definition of global liquidity in order to guide further analysis.

A. Evidence of global financial commonalities

6. Financial shocks and international financial conditions. There is ample evidence that financial shocks propagate internationally, generating positive and negative spillovers (IMF Spillover reports, 2011-13). Typically such financial shock transmission is defined as co-movements in asset prices (interest rates, equity and house prices) and quantities (credit, intermediaries' funding, capital flows) that go beyond what would appear to be justified by economic fundamentals alone. In this context, movements in financial conditions across countries can at times display common patterns. Such patterns can vary over time and may in part be driven by the monetary policy stance in major advanced economies, financial innovation, changes in financial regulation, and related changes in risk appetite of financial intermediaries and asset managers.

7. The increased synchronization of fluctuations in credit and asset prices has been empirically documented. Across advanced economies in particular, synchronicity of credit cycles is high, with some increase over time (see Claessens et al. 2011, and Hirata et al., 2013 and Text Table). A global commonality of credit growth in advanced countries has been highlighted in particular by the BIS (Borio et al., 2011). And evidence suggests that financial synchronization extends to emerging economies, as apparent in the correlation of gross capital flows with the VIX (Rey, 2013, GFSR, April 2014). Indeed, a statistical, latent-variable approach that examines a broad range of country-specific series of various financial variables, and identifies a few common factors (policy related or otherwise) can statistically account for much of the variability in the data (Eickmeier, 2013). A similar approach focused more directly on credit (volume and cost) outcomes confirms the common cyclical features across countries (Box 2). While the international financial conditions seems to be driven by changing conditions in financial centers (in particular the four globally systemic economies – Euro area, Japan, the United States, and the United Kingdom, or "S4"), and correlations are higher across advanced economies (AEs), co-movement extends to many emerging markets (EMs). And while some markets, like China's, have largely remained decoupled, growing financial integration could increase the potential importance of feedback effects from globally systemic EMs to advanced markets and the global economy.

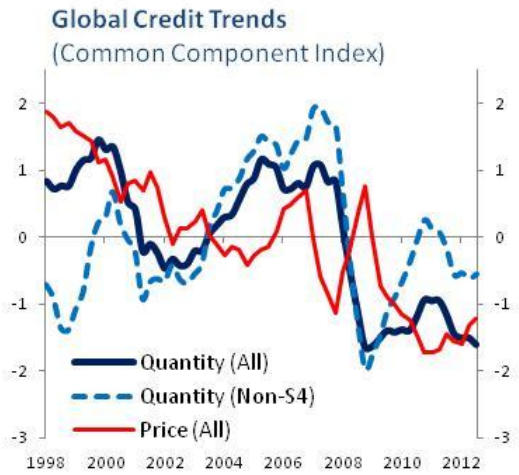
Median Concordance Across Advanced OECD Countries

	Full Sample	Pre-Globalization	Globalization
	1971-2011	1971-84	1985-2011
Output	80.2	73.5	83.2
House Prices	59.2	52.2	63.9
Equity Prices	71.2	63.1	75.3
Credit	69.9	63.2	74.1

Source: Hirata et al. (2011) -- The concordance index measures how frequently two series are in the same phase of their respective cycle.

Box 2. Is There a Global Financial Cycle? A Common Factor analysis

There are various ways to identify commonalities in credit and financing conditions across countries. Claessens et al. (2011) for instance apply classical business cycle methodology to identify turning points and well defined time windows for "upturns" and "downturns" in financial cycles, allowing them to construct indexes of co-movements. Another approach is to employ factor analysis to extract the main common trend, as also used in the April 2014 WEO to explore the commonality in real interest rates.



Considering the quantity and price dimensions of global credit, Annex II conducts a factor analysis, focusing on variables that represent "outcomes" of financial conditions across 40 countries, both AEs and EMs. On the quantity side, the focus is on the (real) growth of total credit to the non-financial private sector from domestic sources (financial, non-financial) and non-residents. On the price of credit, variables include overnight rates; money-market rates; commercial-lending rates; 10-year bond yields; and mortgage rates for each country, all in real terms.

This analysis provides added context to financial developments over the past decade. The estimation of a separate quantity and price index for global outcomes allows for the tentative identification of supply and demand shocks in shaping past credit developments. This enables a more nuanced discussion of past policies, and provides a useful framework to better understand current conditions. The analysis shows for example that, although the cost of credit is generally low currently, credit growth remains relatively subdued, pointing to weakness in demand. While constrained by data availability, such analysis could in principle be extended to terms of credit more generally.

Drivers. Having identified common trends in "outcomes", the next step is to determine the extent to which these are shaped by global drivers. Correlations with selected global variables are illustrative in this regard (see table). Yet the importance of any driving factor may differ, depending on the transmission channel at play, as well as country specific characteristics of individual recipient countries.

Correlations with Common Factors

	Prices	Quantities
Volatility (VIX)	0.12	-0.10
US Credit Conditions Index	-0.55	-0.60
Term spreads		
US Treasury 10/2y spread	-0.44	-0.75
EA AAA Sov 10/5y spread	-0.59	-0.93
UK Gilt 10/5y spread	-0.80	-0.90
Policy rates		
US Fed Funds rate	0.69	0.87
ECB MRO rate	0.61	0.81
BOE OBR	0.73	0.93

Source: Haver, IFS, BIS, IMF Staff calculations.

8. Global liquidity, booms and busts. The run up to the global financial crisis provides the most striking example of how financial conditions in the S4 appear to have driven 2003-08 global conditions. In the context of widespread financial innovation, and with global intermediaries' funding costs closely linked to policy rates, a loose monetary stance and a steep yield curve facilitated increased leverage. As balance sheets grew, and marked to market equity capital rose, lenders' incentives led to looser credit standards (e.g. subprime mortgage). Lower risk measures, expanding intermediaries' balance sheets, and higher asset valuation all reinforced one other. This combination of policy conditions and financial sector dynamics had global consequences as capital

flows surged and vulnerabilities increased that ultimately resulted in distress. Post-crisis, cross-border deleveraging of U.S. and European banks and capital markets reverberated globally. Subsequently, the support provided by the large-scale monetary policy response in the S4, which helped buffer the unwinding of private liquidity in advanced markets, also had global implications. The recent experience with unconventional monetary policies (UMP) and their global impact in particular have been subject to much attention (discussed further in IMF (2013a, 2013c)).

B. An operational definition

9. Global liquidity is still not well understood. Some progress has been made in developing frameworks for analyzing financial trends, especially in a closed economy context. But the understanding and modeling of liquidity remains work in progress and a comprehensive treatment of liquidity in an international setting has yet to be developed (see further discussion in Annex I). The microeconomic underpinnings of international financial intermediation and portfolio-allocation decisions, including managers' incentives, have yet to be integrated with the macroeconomic determinants of capital flows. As such, the analysis of global liquidity is best approached operationally at this time.

10. Global liquidity can be made more precise operationally as the set of drivers of the supply of funds from international financial centers. Consistent with its definition as the ease of global financing and the notion that it is largely determined by conditions in the S4 financial centers, affecting in turn international financial flows to other AEs and EMs, global liquidity can be defined as the set of factors which can lead to a shift in the supply function for cross-border funding. In this simple framing, the supply and demand of cross-border funding are balanced by an equilibrium price (e.g. expected return differentials, adjusted for country specific risks). Yet the willingness to provide such funding is also determined by non-price supply factors.

11. A variety of factors likely matter for determining the ease of cross-border funding. The theoretical literature, as summarized in Table 1, suggests that the ease of cross border funding is affected by the composition of investors' pools, their balance sheet strength, a variety of specific agency problems and other frictions in decision making. The empirical literature has shown that the supply function is affected by (or at least correlated with) the following factors:

- The risk attitudes of major investors, including risk off/risk on episodes, often proxied by the VIX and other similar uncertainty indicators.
- The balance sheet conditions of global banks, captured primarily by leverage (accounting or market based indicators). The size and balance sheet conditions of the shadow banking system.
- The general (as opposed to relative) level of interest rates, through risk taking.
- Monetary policy in S4 economies and some money aggregates such as M2, with link to the supply of funds unclear but probably going through banks' liabilities.
- Macro prudential policies and financial (de-)regulations in countries of origin and destination. Financial innovation.

- The composition of the pool of investors: banks, real money investors, hedge funds, domestic versus foreign residents.

Table 1. Supply Factors of Cross-Border Funding

Driver	Channel/Mechanism	Literature, Evidence
The risk attitudes of major investors, including risk off/risk on episodes, as captured by VIX and other similar indicators.	General uncertainty and market volatility Value-at-risk management Relative performance evaluation	Rey (2013) Bekaert, Hoerova and Lo Duca (2013) Broner et al (2006)
The balance sheet conditions of global banks, captured primarily by leverage, and other financing conditions.	Cross border positions of global banks	Adrian and Shin (2010) Bruno and Shin (2013a)
The general (as opposed to relative) level of interest rates, and slope of the yield curve.	Lower funding costs for global banks give an initial impetus for cross-border risk-taking Currency appreciation strengthens the balance sheet position of borrowers	Borio and Zhu (2012) Bruno and Shin (2013b) Jimenez, Ongena, Peydro and Saurina (2012)
Monetary policy in S4 countries. Some money aggregates such as M2.	International portfolio rebalancing effects of UMP Banks' wholesale funding Non-financial corporations channel capital market financing into domestic banking systems	IMF Spillover reports (2011-13) Bruno and Shin (2013) Hahm, Shin and Shin (2013) Chung et al (2014)
Macro prudential policies and financial regulations in countries of origin and destination Financial innovation.	Prudential policies in source country may affect outflows Macro-prudential and capital flows management tools may limit the impact of inflows Shadow banking	Aiyar, Calomiris, and Wieladek (2012) Beirne and Friedrich (2014) Pozsar et al. (2010) Claessens et al. (2012)
The composition of the pool of investors: banks, real money investors, hedge funds, domestic versus foreign residents.	Reduced home bias Correlated trading Portfolio rebalancing	Hau and Rey (2008) Karolyi et al. (2012) GFSR (2014)

12. This operational definition and set of factors suggest an empirical research agenda for investigating the dynamics of global liquidity. The starting point would be an empirical assessment of the role of each of these factors. The next section presents some preliminary work in that direction. It leads to an assessment of the role of S4 policy settings and their various channels, interest rate differentials, including the level of interest rates, the effect of banks' balance sheets, and their potential effects on risk off/risk on conditions.

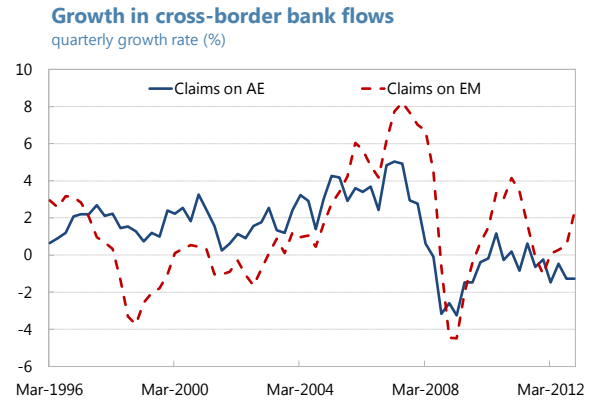
DRIVERS AND CHANNELS OF GLOBAL LIQUIDITY: SOME EVIDENCE

Informed by the evidence of global financial commonalities, and available analytical tools, this section investigates empirically which key factors appear to influence financing conditions in recipient countries through cross border flows. Various propagation channels (i.e., bank and portfolio flows) are explored, taking into consideration the role of recipient-country characteristics and policies.

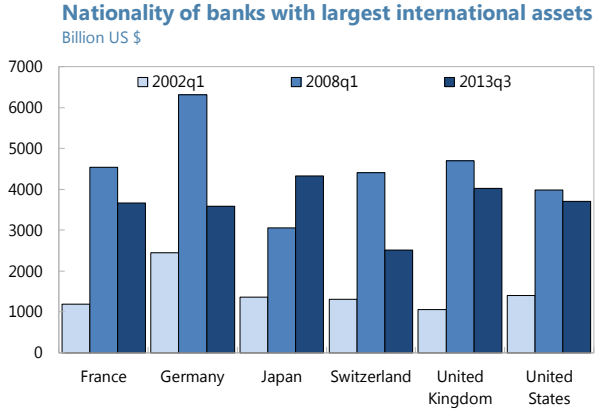
A. What global factors drive cross-border bank flows?

13. The fast growth of cross-border bank funding was a key feature of the pre-crisis period and its subsequent reversal of the post-crisis period. BIS international banking statistics show the predominance (among reporting countries) of a few advanced economies in international bank lending and borrowing. While cross-border lending patterns exhibit heterogeneity in level and growth across destination economies (e.g., between AEs and EMs), they also display strong commonalities over time. The crucial role of advanced-economies' banks in international capital flows is also reflected in balance of payment statistics, where financing through financial intermediaries securities and other-investment inflows have followed very similar patterns.

Flows are Volatile and a Few Financial Centers Dominate Cross-Border Banking



Sources: BIS locational data



Source: BIS table 8

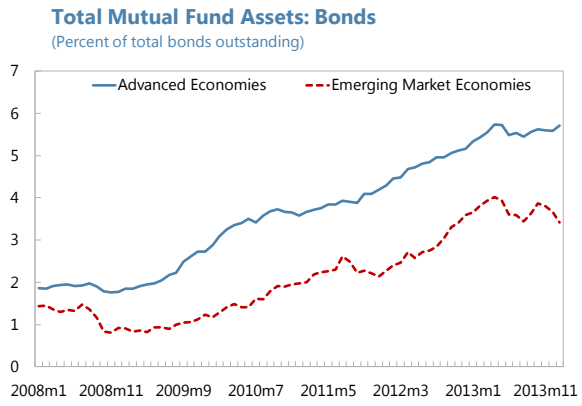
14. An initial empirical exercise focuses on the global drivers of cross-border bank flows, analyzing as well country-specific determinants of flows. There is ample work on identifying and quantifying the impact of global factors on cross-border bank flows. Beyond global factors, however, it is also of interest to explain what drives the heterogeneity in bank flows across countries. This would help our understanding of how countries may differ in their sensitivity to global conditions, and how they can potentially manage their exposure to changing conditions. BIS locational data on gross bank flows from the mid-1990s onwards are used here to study both the global drivers of total flows and the country-specific determinants of country specific (in)flows.

15. Global factors drive cross-border bank flows, alongside evidence of country-specific factors. The findings on global factors confirm the literature, with effects driven largely by the post-1996 (globalization) period. The empirical results confirm the explanatory power of the VIX, as well as the importance of global bank leverage, the U.S. yield curve slope, and M2 growth in advanced countries. Flows decrease in the face of greater volatility and term premia, but increase with global bank leverage and money growth in advanced economies. Furthermore, country-specific flows are found to depend on both global factors and country-specific characteristics (see more details in Annex III).

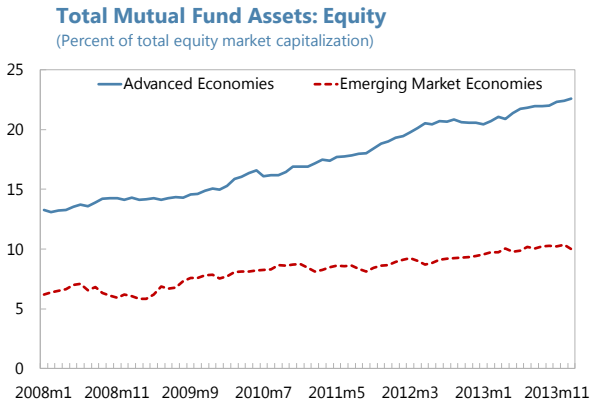
B. What global factors drive international portfolio flows?

16. Another channel through which liquidity conditions in financial centers can be transmitted globally is via international bond and equity portfolio flows. In recent years, asset management firms have significantly expanded their global presence, especially in bond markets. In fact, since 2008, the fraction of bond markets under management by mutual funds has increased almost fivefold in EMs and threefold in AEs. Annex IV discusses the growing role of the asset management industry in the global allocation of funds.

The Role of Mutual Funds in Global Asset Allocation is Growing



Sources: EPFR Global; BIS; IMF staff calculations.



Sources: EPFR Global; Datastream; IMF staff calculations.

17. A second empirical exercise focuses on the transmission of global liquidity through mutual-funds flows. The impact of liquidity conditions in global financial centers (US, Europe and Japan) on portfolio flows to EMs and AEs is investigated using EPFR Global data on mutual fund country flows. Although EPFR data primarily capture the retail component of capital flows, given the greater volatility of this component, it can nonetheless serve as a proxy for the transmission of liquidity conditions through the international portfolio flow channel.[2]

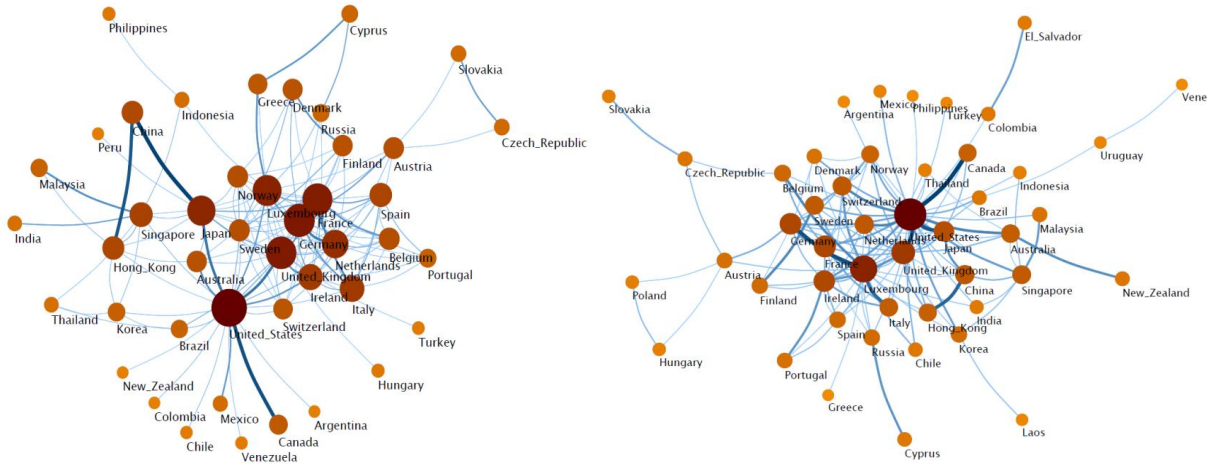
[2] Since the coverage of the EPFR data expands over time, the data is normalized using assets under management (AUM).

18. The role of global liquidity conditions is explored by focusing on S4 indicators. Specifically, the focus is on the components of financial condition indexes for systemic advanced economies – e.g., for the United States, the Chicago Fed's National Financial Conditions Index (NFCI). Similar measures are derived for the Euro Area, Japan, and the United Kingdom, and these are supplemented with other data when necessary (e.g. monetary policy variables, additional measures of term spreads, etc.). The liquidity variables are organized into 5 categories: (i) Price (term spread); (ii) Volatility; (iii) Quantity; (iv) Credit; and (v) Monetary Policy (all the variables used in the analysis are listed in Annex V which provides more details).

19. The empirical exercise explores how much of bond and equity flows can be explained by the selected liquidity variables. The first step consists in ranking liquidity variables within each category to determine the one with the largest explanatory power. The results are robust to alternate specifications (such as lags) and subsamples. In particular, subsamples corresponding to a "first phase" of global liquidity (2003 to August 2008) and a "second phase" (September 2008 onwards) are also tested. Next, the best performing variables in each category are subject to a horse race (see Annex V for more details). In general, the association between global liquidity and portfolio investment is stronger for bond flows than for equity flows. The VIX and the TED spread appear to be important drivers of portfolio flows. Monetary policy conditions, especially in the Euro area and in Japan, are also highly correlated with portfolio flows. Credit conditions matter for bond flows.

S4 Economies Are Central in Global Portfolio Claims Networks

Debt Securities **Equity Securities**



Source: CPIS, 2012 Q4. Network map prepared by staff using the software from Rosvall and Bergstrom (2008).

20. The importance of global factors for portfolio flows relates to the centrality of the S4 financial systems in these markets. The extent of bilateral portfolio exposures is captured in the Coordinated Portfolio Investment Survey (CPIS) data. In the network graph, the strength of bilateral links directly illustrates the main transmission channels of international funding. The centrality of S4

economies in these networks reflects not only their size, but also the extent to which their financial systems serve as conduits in the intermediation of global flows. (see Annex VIII for methodology). Multilateral portfolio exposures have evolved over the course of the crisis, becoming (like their banking counterpart) somewhat more fragmented. Yet the general hub and spoke structure of portfolio channels has been changing relatively slowly.

C. Common drivers

21. Cross-border banking and portfolio flows are affected to a high degree by similar global drivers. The main empirical results as summarized in Table 2 show that several global variables, including the VIX, and the TED spread, co-move with both bank and portfolio flows. Some global indicators such as monetary aggregate play a role in cross-border transmission of bank credit without necessarily being closely linked to common trends in bond and equity flows. And while factors such as the real policy rates (including the "shadow" policy rate in the case of portfolio flows)[3], the term premia in key bond markets, and broker-dealer leverage are statistically significant drivers of cross-border flows, they affect bank flows in opposite directions from bond flows, suggesting different channels as well as substitution effects at work.

22. These relationships need to be interpreted with caution however. The causal importance of any global driving factor may differ, depending on the particular transmission channel at play, as well as the country-specific characteristics of individual recipient countries. In particular, although higher policy rates typically tend to discourage lending, high rates may also indicate a booming economy with strong domestic and cross-border lending activity. Conversely, downturns, and financial crises in major advanced countries especially, can translate into both lower real rates, including policy rates, and subdued cross-border flows. Yet low rates can be also associated with increased bond portfolio flows. Likewise, while a steeper slope of the S4 yield curves (or higher term premium) appears to be correlated with reduced cross-border bank flows, it is related to larger bond portfolio flows to both AEs and EMs. Both effects likely reflect a variety of channels as well as some substitution effects among borrowers between bank and bond financing.

[3] The shadow policy rate is an indicator developed to measure the effects of monetary policy at the zero lower bound. Based on a term structure model, the shadow rate coincides with the policy rate when it is positive, but can become negative when the latter hits the lower bound. The shadow rate used here is drawn from Wu and Xia (2014).

Table 2. Summary of Empirical Results

Drivers		Bank Flows to		Bond Flows to		Equity Flows to	
		banks	non banks	AE	EM	AE	EM
Risk appetite	VIX	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***	(-) ***
	TED spread	(-) *	n.s.	(-) ***	(-) ***	(-) ***	(-) ***
Balance sheets conditions	Broker dealer leverage	(+) ***	(+) ***	(-) ***	(-) ***	(+) ***	(+) *
	Credit conditions in the U.S.	(?)	(?)	(+) ***	(+) ***	(+) ***	(+) ***
Interest rates	Yield curve slope	(-) ***	(-) ***	(+) ***	(+) ***	(?)	(?)
Monetary policy	Policy rates	(+) ***	(+) ***	(-) ***	(-) ***	(?)	(?)
	M2	(+) ***	(+) **	n.s.	n.s.	n.s.	n.s.

(+), and (-) indicate a significant coefficient with positive or negative sign respectively. ***,**, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent levels respectively. n.s. stands for non significant, and (?) indicates inconclusive findings (e.g. different signs across specifications).

23. Results suggest some scope for policy to manage the level and cyclicality of global bank flows.

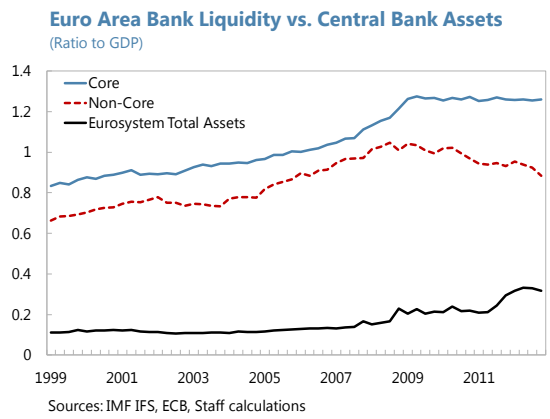
- A more flexible exchange rate regime reduces the cyclicality of cross-border banking flows to bank borrowers, and stricter capital controls reduces the cyclicality of cross-border banking flows to non-bank borrowers. For the bank regulatory measures, greater capital stringency and/or more supervisory power reduce the cyclicality with respect to global liquidity of cross-border claims on banks, but not that of claims on non-banks. Restrictions on foreign bank entry lower in general the cyclical role of the global liquidity factor.
- Other findings of the analysis are that the presence of capital controls and low quality institutions are associated with lower cross-border flows. Similarly, restrictions on foreign-bank entry or ownership of domestic banks reduce flows to both banks and non-banks.

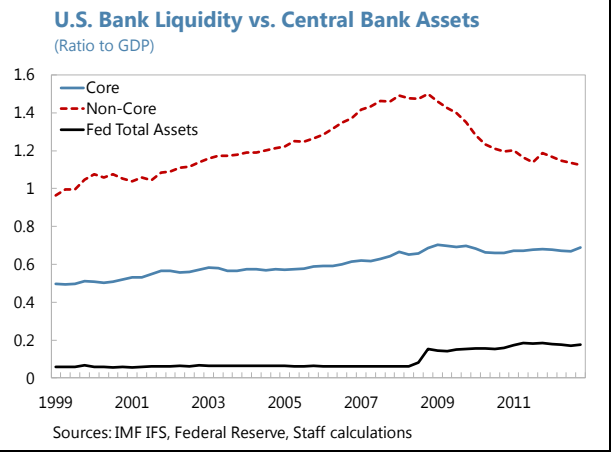
24. Similar results obtain regarding the interaction between portfolio flows and recipient country institutions and policies. Institution quality matters for both bonds and equity portfolio flows. Exchange rate flexibility is important in reducing the impact of global drivers on equity portfolio flows. Similar to bank flows, bond flows are reduced by the presence of capital controls, and equity flows by limits on foreign bank presence.

D. Changing patterns

25. Continuous shifts in international banks' funding structure are an essential aspect of global, private liquidity trends. This topic was explored in detail in the October 2013 GFSR. Of particular interest is the relative importance of "non-core" (wholesale) funding, in line with quantity measures of liquidity previously developed by staff (Chen et al., 2012). Global banks' increased reliance on non-core financing was a key aspect of the surge in balance sheets and cross-border lending that characterized the pre-crisis (2003-07) phase. In parallel, the increase in non-core funding of banks in smaller open economies indicated easier access to a growing pool of cross-border liquidity (with associated vulnerabilities, see Annex VII). The collapse in non-core funding was one aspect of the sharp contraction in private liquidity that motivated the extension of central bank liquidity provision. While official liquidity is usually a small part of the financial system in advanced economies, unconventional monetary policies were warranted in the wake of the Lehman crisis and the Euro area crisis in order to buffer the net impact on financial conditions. Within the Euro area in particular, increased reliance on Eurosystem long term refinancing operations substituted for cross-border interbank lending to crisis affected countries.

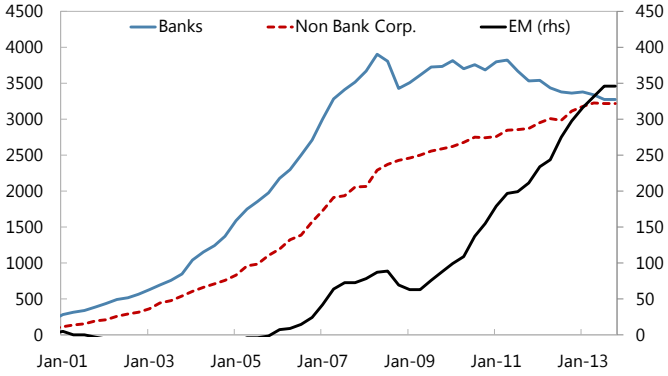
Public Liquidity Provision Has Buffered Private Deleveraging





26. Patterns of global finance have shifted since the crisis, with more reliance on debt issuance, especially by EM corporations. The upward trend in international debt issuance, which came to a halt in 2008, had primarily benefitted advanced economies. Yet the stabilization of the global stock of international debt securities masked an increase in EM international debt issuance since 2010 (Text Chart). Against the background of advanced-economies' bank deleveraging, a general reduction in term premia (including through UMP) and the related search for yield may have widened opportunities for EM corporate bond

Changing Channels of External Debt Financing
Billion US $, cumulative BoP portfolio debt liability flows, excluding US



Source: IMF BoP Statistics, working data

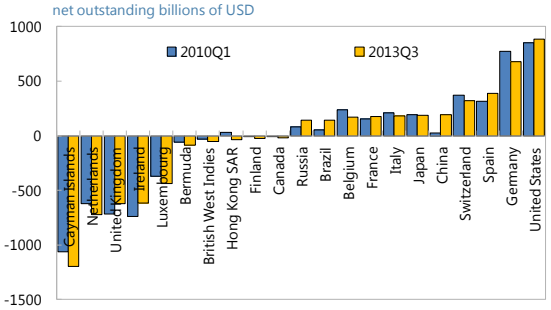
issuance. Ongoing regulatory changes, such as the transition to Basel 3, may also have contributed to shifting some intermediation from banks to capital markets. Shin (2013) highlights this phenomenon as a feature of the "second phase of global liquidity" (see also Turner (2014)). Striking new features have been the access gained by "frontier markets" to international funding through debt issuance, and EM international debt issuance that is increasingly taking place off-shore (Box 3). This illustrates how the vehicles of cross-border liquidity transmission can change over time, especially in response to crises.

Box 3. Off-Shore Liquidity, Users and Providers

While the main users and providers of offshore debt issuance have generally remained the same, with advanced economies continuing to be the main users, the presence of EMs as users has been growing. BIS data shows that AEs' reliance on off-shore debt, which had surged in the immediate pre-crisis years, has since followed a steady decline, as EMs took up a larger share. Issuance out of off-shore financial centers overall not only stabilized, but even increased since 2010.

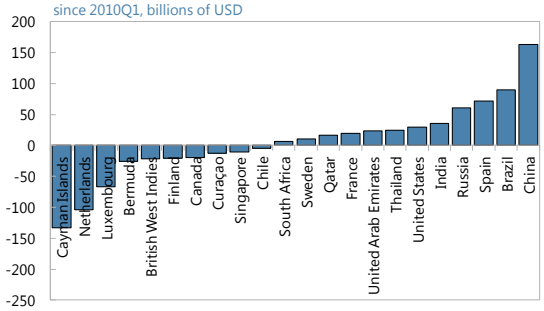
The increase in offshore debt issuance has been the largest in volume for China, with Brazil and Russia recording sizable increases in issuance as well. Annex VI provides more sector level details on recent patterns in off-shore issuance.

Suppliers and users of offshore debt 1/
net outstanding billions of USD



Sources: BIS debt securities by nationality and residence
1/ As a difference of issuances by nationality and residence capturing offshore issuance of foreign incorporated subsidiaries.

Change in offshore users 1/
since 2010Q1, billions of USD



Sources: BIS debt securities by nationality and residence
1/ As a difference of issuances by nationality and residence capturing offshore issuance of foreign incorporated subsidiaries.

Aside from the foreign currency denominated debt issued onshore, offshore financing for the purpose of operations at home is sizable especially for China and Brazil. Balance of payment statistics broadly confirm that funds raised by offshore subsidiaries returned to parent companies in the form of reverse investment (i.e. FDI) increased in recent years. Unless such intercompany lending is included, currency mismatch risk may not be fully captured in external debt vulnerability assessment.

Increased usage of offshore financing by EM suggests the need to better trace how this liquidity finds its way into EM domestic financial systems, and whether this may have resulted in new vulnerabilities. Chung et al. (2014) suggest that such offshore foreign currency borrowing by firms may turn up in corporate local currency deposits, making the case for monitoring this type of monetary data.

LIQUIDITY INDICATORS AND FUND SURVEILLANCE

27. The review and analysis in this paper suggest a variety of indicators pertaining to global liquidity that could be monitored for Fund surveillance, and in many cases already are. The analytical building blocks and the empirical work conducted so far suggest looking in particular at a few key "drivers" of the global financial cycle. Unsurprisingly, policy rates, yield curve configurations, but also the size of balance sheets in major funding economies, warrant special attention. Yet these factors provide different incentives for various sets of agents, through mechanisms that evolve over the cycle, and which change in line with shifting market structures. Different possible combinations of private and official liquidity conditions warrant monitoring of multiple indicators for surveillance. There is therefore a need to look not only at a variety of drivers, but also to monitor quantity indicators that capture how conditions in money centers are being transmitted through intermediaries' balance sheets, cross-border flows, and to compare these with indicators of country-specific credit outcomes.

28. The monitoring of multiple drivers, transmission flows, and outcomes indicators can be organized into a dashboard. While many relevant variables are already monitored in various Fund surveillance vehicles, the extent of monitoring often remains constrained by data availability (see Box 4) and the level of Fund access to existing datasets.[4] Within existing limitations, the rationale of the dashboard is to: (a) focus on a few key available variables that are identified in the literature and in staff work – and confirmed here – as summary indicators of global conditions, or highly correlated with cross-border funding and other manifestations of the global financial cycle; and (b) provide a simple tool for crosschecking the relative position of these indicators in an organized manner, consistent with the underlying analytical framework.

[4] For example, several countries reporting to the BIS International Banking Statistics limit the Fund's access to the full restricted dataset. This group includes important banking systems and also key off-shore financial centers.

Box 4. Efforts to Bolster Data on Global Liquidity

Monetary and financial statistics, reported by country authorities on a monthly basis to the Fund, can be used to supplement the monitoring of global drivers with a range of country-specific outcomes (see discussion in IMF, 2013b, Box 1). In particular, the standardized reporting forms (SRFs) database available for 142 countries provide consistent and detailed breakdown of non-core bank funding indicators (as used in Annex VII). The SRFs database also includes breakdowns between local currency and foreign currency for all categories of liquidity, as well as detailed breakdowns by sector, including the nonresident sector. These elements can be useful in assessing the risks of currency and liquidity crises. Accordingly, the Fund is currently working on developing more precise measures of noncore liabilities based on the SRFs database.

Still, much work is needed to improve data on transmission of global liquidity. Timeliness of data reporting is also of the essence for surveillance purposes. Data limitations in terms of high frequency information on leverage and capital flows still hamper a comprehensive monitoring of international liquidity conditions. In particular, detailed data on *bilateral* cross-border flows would provide a better understanding of the respective role of country specific push and pull factors in international capital flows. A more granular delineation of the composition of the pool of international investors would provide further insight on the channels – for example, the extent of portfolio rebalancing and home bias reduction – that affect cross-border funding. A closer examination of the balance sheet structure of the large EM financial intermediaries would also be of interest.

29. While we lack a strong basis to consistently define neutral values for liquidity indicators, large variations can raise flags. The approach taken is to convert the variables of interest into scores indicating by how much they deviate from their historical mean, expressed in number of standard deviations. Large scores (in absolute value) warrant attention, yet when it comes to policy variables, such deviations need not provide normative signals of excess/lack of public liquidity provision. Indeed large scale policy action highlighted by one indicator may well be required to buffer private liquidity dynamics that would be reflected in a separate set of indicators. Further work is needed to explore ways to translate indicators into signals for policy responses, and to identify new relevant measures over time.

30. This approach highlights the stylized features of liquidity conditions, and illustrates well the recent stages of the cycle. The standardized variables clearly show the build-up of credit prior to the crisis, the evaporation of liquidity during the crisis, with a surge in flows to safe havens (US, Germany), as well as post-crisis flows to EMs. It suggests that recent credit outcomes are still (relatively) subdued, while bond and equity flows have been stronger amid accommodative monetary conditions, including unconventional policies. It also shows the variability of cross-border transmission to EMs as policy drivers in the S4 are shifting. The contrast between pre-crisis global factors (low spreads, high policy rates) and current conditions (low policy rates, high spreads) brings out the need for nuanced analysis of driving factors. Recent developments are discussed in the WEO and GFSR (2014).

31. A range of options are available for integrating these indicators within the Fund's existing surveillance products. Country specific circumstances and time-varying factors call for differentiated policy responses to international liquidity patterns. Liquidity spillovers may be beneficial for recipients. Yet, to the extent that domestic countercyclical policies are rendered less

effective, or to the extent that financial stability is more at risk, changes in international financing conditions may also entail significant welfare costs. This motivates the need to take into account liquidity conditions to formulate adequate policy responses, both domestically and globally.

- *Multilateral surveillance*. The use of liquidity conditions analysis begins with multilateral surveillance, where the Fund is already monitoring many of these indicators. In the context of the WEO, the global features of financial cycles could be a useful complement when considering the consistency of projections. In the context of the GFSR, global factors are of interest for high frequency surveillance of liquidity conditions, and are already monitored closely (Dattels et al, 2010). The surveillance notes prepared by the staff as background for G-20 meetings could also be a vehicle to provide updates to the membership on global liquidity.

- *Integration with bilateral surveillance*. The spillover reports are another natural outlet to study the interaction between systemic policy shocks and global conditions. Moreover, assessing the risks implicit in global financial conditions could form part of the deliberations in constructing the Global-Risk Assessment Matrix that feeds directly into bilateral surveillance discussions. The integration of some aspects of liquidity condition analysis in Vulnerability Exercises regularly conducted by staff also seems warranted. Risk assessments would be further informed by focusing on country-specific effects of global liquidity conditions.

32. Going forward, further work would help expand our understanding of the drivers and effects of global liquidity, and its implications for surveillance. A key challenge for the profession is identifying the price and non-price factors driving the supply of global funding, and exploring their general equilibrium properties and country-specific repercussions. In this context, next steps for staff will include:

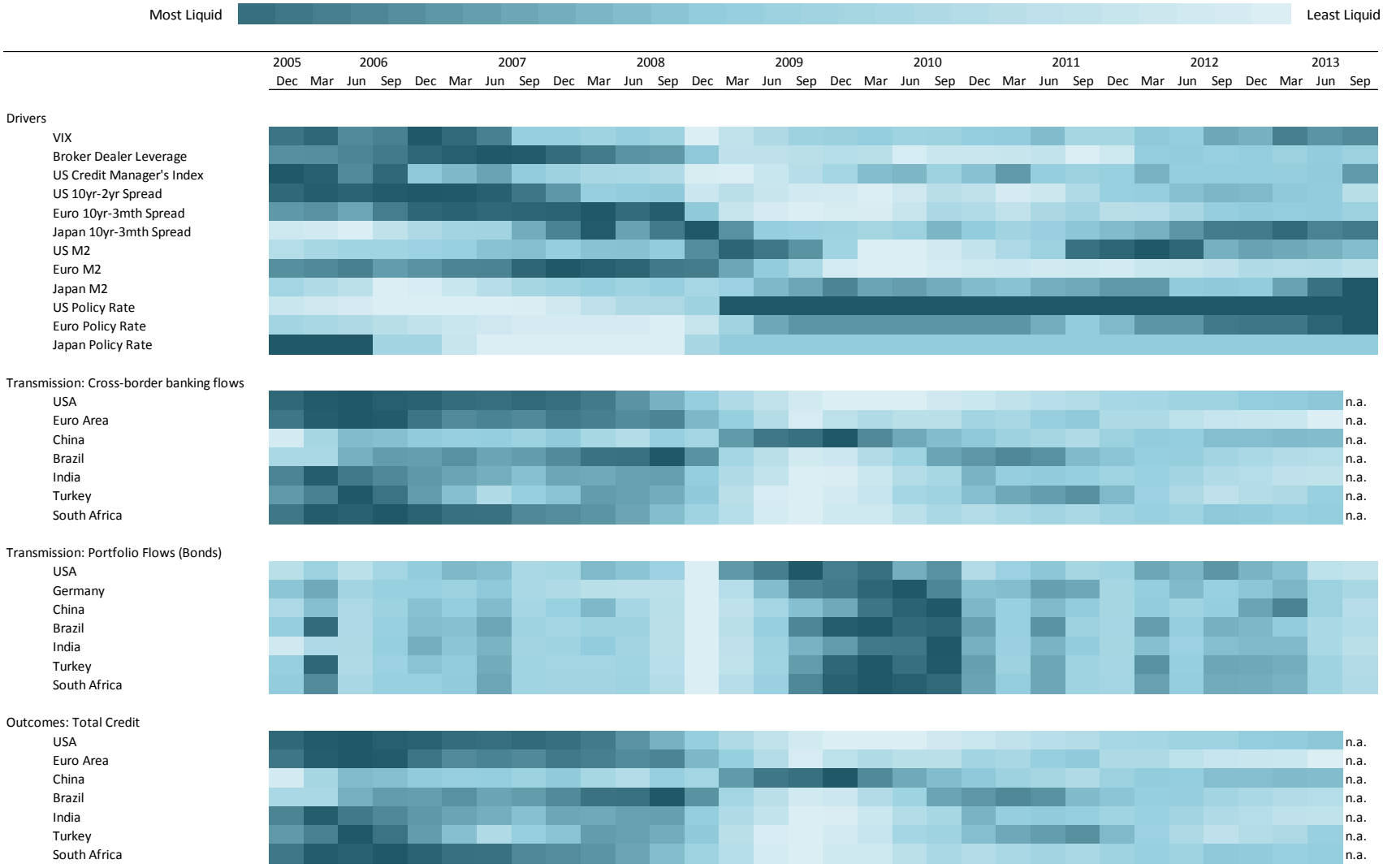
- Revisiting and enriching the conceptual foundations and empirical validity of the drivers/transmissions/outcomes framework. Especially, private liquidity creation in systemic economies, and its links to shadow banking, is of interest (staff will be probing further into this issue, including in the Fall 2014 GFSR).

- Further assessing the value of monitoring indicators such as those in the "dashboard".

- Considering the development and use of simple, available indicators to support a more systematic and regular monitoring of global financial conditions in staff's bilateral and multilateral surveillance.

Dashboard of Liquidity Drivers, Transmission Channels and Outcomes (Selected Economies)

Darker (lighter) shades of blue indicate **looser** (tighter) liquidity conditions, relative to the historical distribution of each variable over the 2005-13 period.



Variable	Definition	Units	Source
Drivers			
VIX	CBOE S&P 500 Volatility Index (VIX)	Index	Haver Analytics
Broker Dealer Leverage	(Equity + Total Liabilities)/Equity.	Index	US Flow of Funds series published by the US Federal Reserve
US Credit Manager's Index	National Association of Credit Managers Index	Index	Haver Analytics
US 10yr-2yr Spread	10yr/2yr Coupon Equivalent Par Yields	Percent	Haver Analytics
Euro 10yr-3mth Spread	10yr/3month Coupon Equivalent AAA Governmet Bond Par Yields	Percent	Haver Analytics
Japan 10yr-3mth Spread	10-Year Benchmark Government Bond Yield over 3-month JPY LIBOR	Percent	Haver Analytics
US M2	Money Stock: M2 (SA)	Annual Change (Percent)	Haver Analytics
Euro M2	EA 11-17: Money Supply: M2 (SWDA))	Annual Change (Percent)	Haver Analytics
Japan M2	New Money Stock: M2 (SA)	Annual Change (Percent)	Haver Analytics
US Policy Rate	Federal Funds Target Rate	Percent	Haver Analytics
Euro Policy Rate	Euro Area Main Refinancing Operations Rate	Percent	Haver Analytics
Japan Policy Rate	Japan Discount Rate	Percent	Haver Analytics
Transmission			
Cross-Border Banking Flows	External Positions Of Reporting Banks vis-à-vis Individual Countries, all sectors	Annual Change (Percent), Exchange-Adjusted from 2013Q3 positions	BIS Locational Banking Statistics, Table 6A
Portfolio Flows	EPFR Bond Funds Country Flows	Percent of Assets Under Management (AUM)	Haver Analytics
Outcomes			
Total Credit (Real)	Total Credit to the Non-Financial Private Sector, all sources	USD, Deflated by Local CPI, Annual Change (Percent)	BIS Total Credit Statistics

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Annex I. Real Economy and Liquidity Cycles[1]

The state of knowledge on the drivers of global liquidity, defined as the "ease of international financing" is limited. The factors driving the ease of financing globally and how they can affect countries are not well understood (for recent reviews see Landau (2013), Shin (2012), CGFS (2011), and Obstfeld (2009); see Holmstrom and Tirole (2011) for an analytical overview of the determinants of liquidity and its private and public management). This lacuna reflects the more general limited knowledge on the roles and effects of financial markets in creating, transmitting and propagating shocks. With this caveat, it is clear that any fuller understanding of global liquidity will occur at the intersections and integration of a number of research areas, some well established, others being explored only more recently.

One strand is the financial accelerator. This channel, largely operating through the demand side of financial transactions and extensively studied within the domestic context, describes how changes in balance sheets of borrowers can amplify macroeconomic fluctuations (Bernanke and Gertler (1989), Carlstrom and Fuerts (1997), Kiyotaki and Moore (1997)). The central idea underlying this channel is a propagation mechanism. Shocks, such as fluctuations in asset prices or changes in real economic prospects, influence the balance sheets of borrowers. Given financial imperfections, resulting changes in the net worth of borrowers then affect the volume of external finance supplied and the cost of capital they face. These propagation mechanisms can have general equilibrium effects as individual agents' actions affect others in a mutually reinforcing fashion and lead to procyclicality (Bernanke, Gertler and Gilchrist, 1999).

The financial accelerator mechanism has also been studied in the context of open economy models. While the mechanisms are similar to the domestic ones, the relevance of financial imperfections is probably even stronger in an open economy context because contracts are harder to enforce and information asymmetries are greater across borders. As a result, pledgeability of output and verifiability of borrowers' quality is more limited and net worth influence access to finance more so than in the domestic context. As exchange rate and asset prices increase and countries' net worth rises, the volume of external financing is likely to increase while its cost declines. Conversely, as net worth declines, the volume of external finance falls while its cost increases. This propagation mechanism has been shown in open economy models to be quantitatively important in explaining how external financing can be procyclical (e.g., Gertler, Gilchrist and Natalucci, 2007). Recent research has also analyzed how such mechanisms can help explain the highly synchronized nature of the global financial crisis (Perri and Quadrini, 2010).

Another strand is associated with the supply side of financial transactions. It emphasizes the importance of balance sheets of banks and other financial institutions in providing financing and liquidity and in determining asset prices, and the broader implications of the state of financial intermediation for the real economy. Changes in the net worth of an intermediary will affect its

[1] Prepared by Stijn Claessens (RES) based on Claessens and Kose (2014).

access to and cost of funding and its ability to make new loans and undertake other intermediation activities. These effects can be a source of aggregate cyclical fluctuations through what has been called the bank capital channel (Van den Heuvel, 2008). When many banks are affected by the same shock, economic wide effects can occur. For example, during a recession, the quality of loan portfolios weakens, adversely impacting banks' balance sheets. In order to shore up relative capital positions (as desired by the market or to satisfy regulatory requirements) and being unable to raise capital quickly, banks may tighten their lending standards and reduce the volume of risky credit they provide. This "credit crunch" can lead to a slowdown in activity, or even a recession, with more non-performing loans and deteriorating bank balance sheets. With this mechanism, a strong link can arise between capital and the supply of bank financing.

Some recent studies have focused on (endogenous) cycles in leverage. A closely related, but less studied channel is associated with leverage and how shocks stemming from the supply side of finance can have an important impact on the real economy. Models and analyses by Adrian and Shin (2010, 2011) show that, when measured capital is high, risks are perceived to be low and internal risk models and other indicators suggest limited exposures, banks' balance sheets will tend to expand and leverage to increase (similar relationships can exist for other intermediaries). Since this is more likely when interest rates are low and asset prices relatively high, the monetary policy stance can affect private financing provision. Dell'Ariccia and Marquez (2013) review the link between real interest rates and bank risk taking, and its implications for monetary policy are articulated by Borio and Zhou (2008). Generally, a "search for yield" can occur among banks and institutional investors when interest rates are relatively low. Conversely, equilibria in financial markets can shift rapidly, with many non-linearities, some akin to the self-fulfilling (currency) crises (Obstfeld, 1986), with adverse effects on the supply of liquidity and external financing. Geanakopolos (2010) shows how macroeconomic conditions, including easy monetary policy, can trigger leverage cycles, with booms and busts in the supply of external financing.

Some of these supply side channels also apply to the international context, even though they have been less well studied to date. While some channels are less relevant in an international context (small firms for example generally do not have access to cross-border loans), the bank capital and leverage channels are quite relevant internationally. The capital channel was clearly shown when international banks pulled back from cross-border lending after the recent financial crisis with the degree depending on how severe their balance sheets were hit (Cerutti and Claessens, 2014). Bruno and Shin (2013a and 2013b) model how the capital and leverage channels can give rise to procyclical international lending behavior and demonstrate the empirical relevance of these channels for cross-border banking flows. Hahm, Shin, and Shin (2013) show how reliance on non-core funds help predict banking system vulnerabilities, exactly because it proxies for ease of funding conditions. Chung et al (2014) show how non-core liabilities of international banks, that reflect the activities of non-financial corporations, signal broad credit conditions and predict global trade and growth (see also Shin (2013)). More generally, Rey (2013) attributes the high co-movements in international financial markets to similarities in funding conditions and balance sheets positions of international active banks and other intermediaries located in key financial centers.

Annex II. Common Component Analysis[1]

1. Methodology

We apply a factor model to a broad set of credit indicators, based on the approaches of Stock and Watson (2002), Bai and Ng (2002) and Eickmeier and others (2013). The aim is to explore the global commonality in the dynamics of these indicators; defined as the share of variance explained by a common factor, as estimated via factor analysis.[2] The analysis proceeds as follows:

- A large set of credit indicators, across a wide range of countries, is combined into a single cross-country dataset, where each indicator is centered and standardized.
- The data are separated into i) price variables, and ii) quantity variables.
- The first principal component is then extracted from each of these separate cross-country samples
- In each case, this latent first component then represents the common "global" portion of cross-country liquidity, and so serves as a single indicator of either the price or quantity of global liquidity.

2. Data

Our analysis focuses on liquidity-related "outcomes" across a wide range of countries, which capture the net result of a broad set of channels. For quantity, therefore, we use the BIS data for Total Credit to the Private Sector, which is available quarterly for 40 countries, both advanced and emerging, and covers total credit provided by: domestic banks, all other sectors of the economy, and non residents. For prices, we use a range of local domestic interest rates, including: policy rates; money-market rates; 10-year government bond yields; commercial lending rates; and mortgage rates. Our sample ranges from 1998Q4 to 2013Q2. Quantity variables are expressed in real USD terms, and are (log) differenced. Interest-rate variables, on the other hand, are expressed in (real) levels.

[1] Prepared by Andrew Tiffin (SPR)

[2] The key purpose of Principal Components Analysis (PCA) or Factor Analysis (FA) is to find the best low-dimension description of the variation in a large multivariate dataset, by representing the co movement of correlated variables through a lower number of unobserved latent "factors" (or components). The literature sometimes distinguishes between PCA and FA; noting that the former is typically employed as a statistical data-reduction technique, in which the resulting components are constructs without any necessary real-world interpretation. Factor analysis, on the other hand, is typically guided by a set of prior hypotheses on the number of underlying drivers and their interpretation. Our analysis is more in line with the latter approach, as we explicitly divide our sample into price- and quantity-related variables, and then only take the first factor as our index of the "global" common trend for each of these concepts.

Principal Components Analysis requires a balanced sample, so we exclude all series with less than eight years of data. Any remaining data gaps are imputed using iterated chained equations across the full dataset (see White and others, 2011).

Although the BIS total-credit data are relatively comprehensive, they may nonetheless be subject to exchange-rate movements; as loans can be denominated in multiple currencies, particularly cross-border loans,. As a robustness check, therefore, we consider as an alternative quantity indicator the amount of cross-border bank credit flowing into a country, which is available on an exchange-adjusted basis from BIS locational data. As a final robustness check, and more in the spirit of Eickmeier and others (2013), we extend the analysis beyond a single quantity measure; extracting the common global component instead from a broader range of local quantity-related variables. These include: M0 growth; M2 growth; cross-border credit growth; and domestic-currency loans from local affiliates. Also in the spirit of Eickmeier and others (2013) this latter analysis is framed in nominal terms, and includes a number of global factors: with the VIX and US term spreads included in the price analysis; and with US repo volume growth and commercial-paper growth included in the quantity analysis.

3. Results

The extracted first components, and their background data, are illustrated in Figure 1. Each component should be interpreted as a (standardized) index. The figure highlights the fact that, although there is substantial variation around the estimated common component, the index captures most of the main features of global liquidity over the past decade. Indeed, the single price index represents around 45 percent of the total variance of the cross-country price data, whereas the quantity index presents almost 40 percent of the quantity-data variance.[1] The figure also includes price and quantity indexes calculated over two subsamples: S4 countries, and non-S4 countries. These sub-sample indices are broadly similar to their total-sample counterparts, suggesting that the two groups were generally coupled over the sample period.

- The quantity series captures the contraction following the 2001 dot-com bust, the long easing over the mid-2000s, and the sharp drop following the 2008 crisis. At present, the index suggests that credit remains relatively subdued.

- The price index covers the easing of policy rates following the dot-com bust, and the subsequent increase of policy rates after 2004. Price developments surrounding the crisis, however, are dominated by the impact of inflation on real financing conditions. The surge of oil and commodity prices over the final portion of the 2002-2008 boom, particularly in 2007, prompted in a general CPI increase across the sample; which in turn resulted in an effective easing of real financing conditions. Following the crisis, however, the drop in commodity prices and inflation added to an effective tightening of real rates. Currently, global funding costs

[1] The price data includes 59 observations over 112 variables, and the quantity data includes 59 observations over 40 variables.

remain relatively low; although in real terms, the recent downward trend in inflation has produced a slight tightening of conditions.

The robustness checks are presented in Figure 2, using different quantity measures in the construction of the global quantity index. Broadly, the measures capture the same broad patterns, although the final indicator, based on nominal data, does not display the same inflation-based swings in prices during the period immediately before and after the global financial crisis.

4. Extension: Supply and Demand

Identification of shocks. With an index in hand for both price and quantity, we can apply the methodology developed by IMF staff in Chen and others (2012) to decompose the movements of either index into the result of both supply and demand shocks.

Briefly, the two indexes are modeled within a bivariate vector autoregression (VAR), in which the detrended indexes are regressed on their own lagged values and a constant. From the reduced-form residuals of the VAR, we then construct *structural innovations* that are serially and contemporaneously uncorrelated. In addition, we impose *sign identification restrictions* to assign a meaningful economic interpretation to these structural innovations. This approach has been used widely in the literature to identify various macroeconomic shocks driving the business cycle (see Canova and De Nicolo, 2012; Uhlig, 2005; and Peersman, 2005).

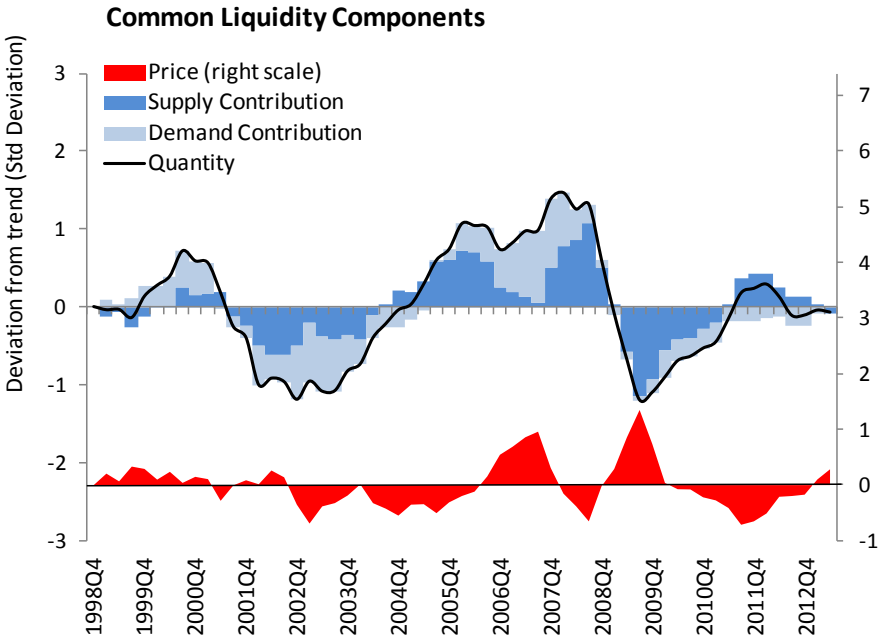
In our case, to identify supply and demand shocks, we assume that a positive demand shock for global liquidity would lead to an increase in both the price and quantity of credit; while a positive supply shock would be accompanied by a fall in the price and an increase in quantity.

Mechanically, we start with the usual translation of the reduced-form VAR into a structural model by multiplying both sides of the VAR by the inverse of the Cholelsky decomposition. We further note, however, that any matrix $(PQ)^{-1}$, where P is the Cholesky decomposition and Q is an orthonormal matrix, will achieve the same result. We can thus choose a Q that ensures that the impulse response of the resulting model matches our identify restrictions. In this context, however, different rotations (different Q) of the matrix P will yield observationally equivalent models, so that there will actually be an infinite number of models with impulse responses that match our restrictions, albeit with different magnitudes. To choose a specific model, then, we use a *median targeting* approach, which chooses a model that yields impulse responses as close as possible to the median response among 10,000 randomly selected models (see Fry and Pagan, 2010).

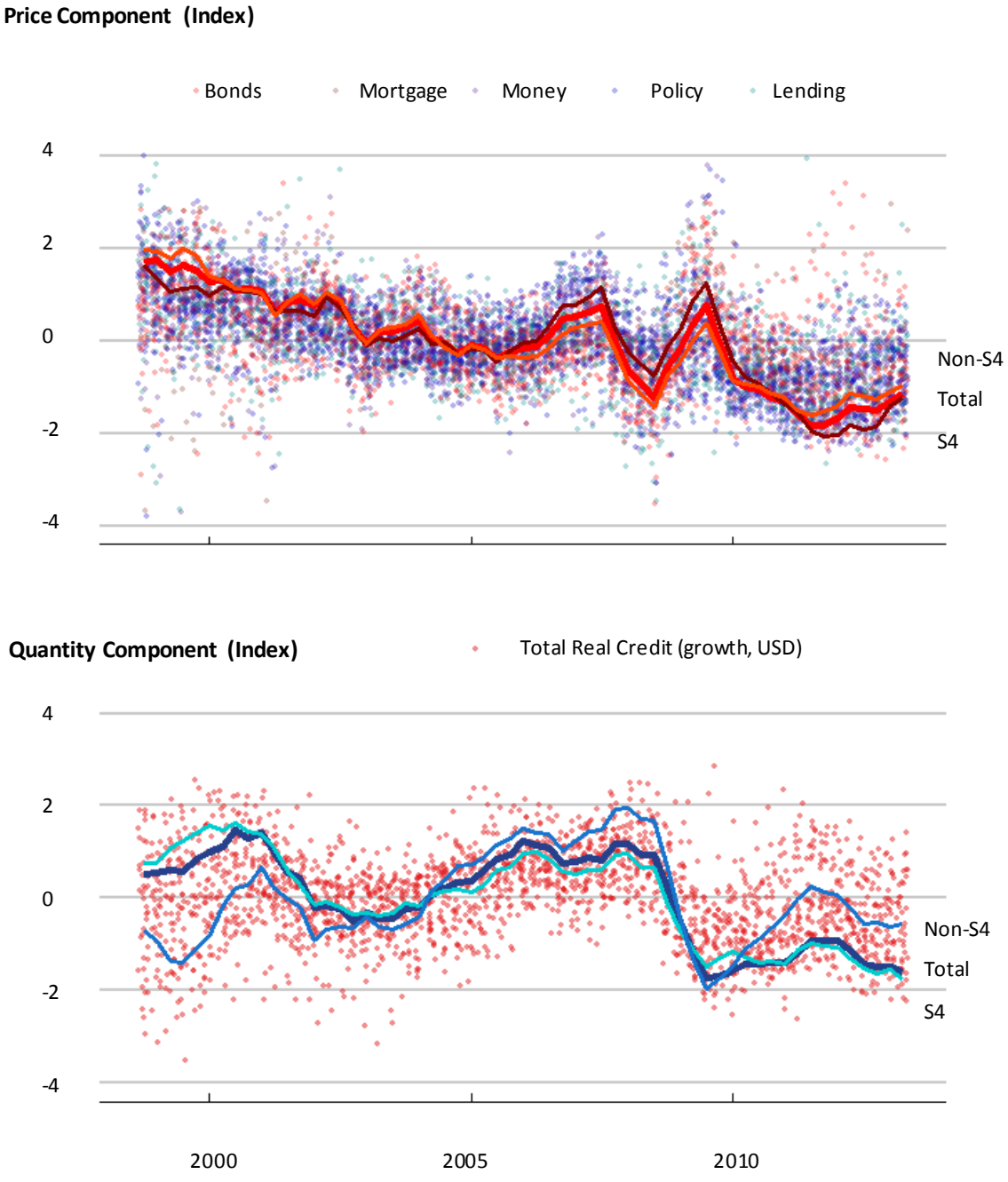
Having identified individual supply and demand shocks, we use a historical (Wold) decomposition procedure to outline the cumulative contributions of supply and demand to both the price and quantity of global liquidity.

The results are illustrated in the chart below, which shows both detrended series, and the decomposition for the quantity index. Given the variation of individual-country data around the estimated price and quantity components, and given the components' somewhat abstract nature,

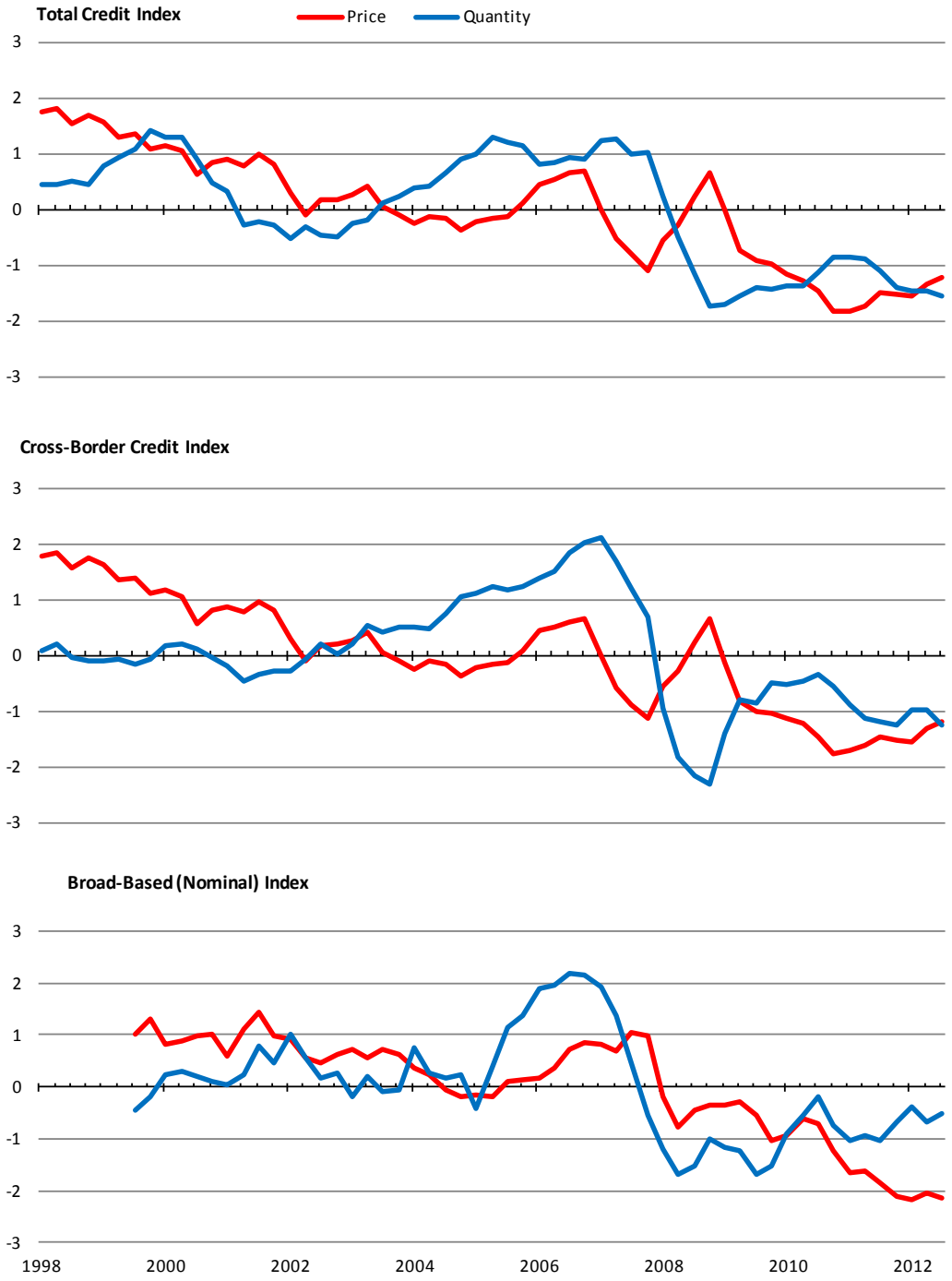
these results are subject to the usual caveats. Nonetheless, a number of features stand out: including an expansion of supply that helped keep prices down and so potentially prolonged the boom over 2002-08; the sudden contraction of supply associated with the crisis; and the suggestion that recent efforts to boost supply (perhaps though expansionary policy) are currently being offset by subdued demand.



Annex II. Figure 1: Global Credit – First Principal Components



Annex II. Figure 2: Global Credit Indexes - Robustness Tests



Source: Haver, IFS, BIS, and IMF Staff Calculations

Annex III. Global Liquidity and Cross-Border Bank Lending[1]

Cross-border bank lending increased sharply from the mid-1990s until the global financial crisis erupted in 2007/08, and contracted sharply afterwards. As such, cross-border bank lending is an important aspect of global liquidity. The objectives of this section are to: (i) Document which drivers of global liquidity are statistically correlated with the evolution of cross-border banking lending to banks and non-banks over the period; (ii) Investigate which borrower countries' policies and characteristics (e.g. exchange rate regimes, participation of foreign banks in domestic banking sector, banking regulation, etc) play a role in dampening or amplifying the impact of global liquidity indicators on cross-border banking lending.

1. Data

BIS International Banking Statistics are used for capturing cross-border banking claims. The analysis uses the BIS Locational data for the following reasons: (i) it provides a long time span, much longer than the BIS Consolidated banking statistics (often only consistently available from the mid-2000s); and (ii) it provides exchange rate adjusted series for the sectoral breakdown of banks and non-banks. The data series covers the period 1998-2012, includes 42 countries, and breaks down the evolution of exchange rate adjusted cross-border banking claims by bank and non-bank borrowers.

Individual drivers of global liquidity, a summary global liquidity measures as well as country level controls are explored. Individual global liquidity drivers – such as bank leverage, interest rate, VIX and other similar risk indicators, and monetary aggregate measures – are investigated, while country demand factors are also included as controls. Using summary measures (quantity and price) of global liquidity – obtained from a principal component analysis of global credit using the cross-border banking claims – the role of country-specific characteristics in affecting the impact of global liquidity is explored.

2. Empirical Specification

The base estimation consists of a panel regression with country fixed effects and clustered standard errors at the borrower country level:

$$\Delta L_{jt} = \beta_0 + \beta_1 Global\,Liquidity_t + \beta_2 Domestic\,Factor_{jt} + \beta_3 \Delta InterestSpread_{jt} + \gamma_j + \varepsilon_{jt}$$

Where:

- Dependent variable ΔL_{jt} is the quarterly log difference in the exchange rate adjusted stock of banking claims in borrower country j at time t. Two different dependent variables are used: the change in the stock of BIS Locational cross-border claims on the banking sector of borrower

[1] Prepared by Eugenio Cerutti and Lev Ratnovski (both RES)

country j, and the change in the stock of BIS Locational cross-border claims on the non-bank sector of borrower country j.Individual Global Liquidity drivers or summary Global Liquidity Measures.

- Domestic factors = GDP growth and Inflation, to proxy for credit demand.
- Delta Interest Spread = Change (current quarter minus 4 quarter lag) in the spread between local lending rates and US Fed Fund Rate.

Interaction variables are introduced to analyze the factors that amplify or dampen the potential impact of global liquidity indicators on cross-border banking lending.

$$\Delta L_{jt} = \beta_0 + \beta_1 Global\,Liquidity_t + \beta_{11} Global\,Liquidity_t * BorrowerCharacteristics_{jt} +$$
$$+\beta_2 Domestic\,Factor_{jt} + \beta_3 \Delta InterestSpread_{jt} + \beta_4 BorrowerCharacteristics_{jt} + \gamma_j + \varepsilon_{jt}$$

Borrower characteristics included as interacted variables (and also directly) are: (i) type of exchange rate regime, (ii) use of capital controls; (iii) general institutional development (rule of law, investment risks, etc.); and (iv) bank regulatory variables.

3. Results

- Results (Table 1) indicate that country characteristics proxying demand and creditworthiness – lagged GDP growth and lagged inflation – are statistically significant factors in cross-border lending. And changes in interest differentials are negative (and statistically significant across many specifications), indicating that larger differentials deter rather than encourage cross-border banking flows, especially for claims on banks, suggesting higher local rates lead to perception of risks.
- As the existing literature highlights (e.g., McGuire and Tarashev 2008, Addjiev, Kuti, and Takas 2012, Bruno and Shin 2013a, Cerutti 2013), individual global liquidity indicators (e.g. VIX, Ted Spreads, leverage, US interest rate and yield curve slope, as well as M2 growth in advanced countries) are statistically significant drivers of cross-border banking lending. VIX and Ted spreads have the expected negative signs, indicating that higher risk is associated with lower growth in claims. Global bank leverage has the expected positive sign, but there is no consistent evidence that US credit conditions affect flows. Relatively, though not as significant across specifications, the level of the real US interest rate has a positive sign, indicating that in general during less favorable economic conditions in major advanced countries – when interest rates are lower, global banks provide fewer cross-border loans. The US yield curve slope has a negative coefficient, signaling that a steeper yield curve leads to lower cross-border flows as well, suggesting search for yield motives are not as important when other investment opportunities and economic perspectives are controlled for. M2 growth in S4 countries is a statistically significant positive associated with flows.
- There is evidence that factors such as VIX, global bank leverage, and M2 are associated with larger changes in the cross-border claims on banks (Panel A) than with those claims on the non-

banking sector (Panel B). These coefficients are significantly larger in Panel A than in Panel B. When comparing the effects of all drivers, VIX and global bank leverage are consistently the most important and significant drivers of cross-border claims on banks and non-banks across specifications in our sample.

- Using the cross-border quantity based common "global" portion of cross-country liquidity (see Annex III) in Table 2, we confirm that this global liquidity measure is a statistically significant driver of cross-border banking claims on banks (similar regression results are obtained for claims on non-banks). A one standard deviation in the global quantity measure implies a 2½ percent change in the quarterly change of cross-border claims on banks (and 1½ percent for non-banks). Overall, the summary global liquidity measure provides most explanatory power (about a 7 percentage points increase in R^2, column 2 vs. column 1), more than any of the other variables (and the R^2 s are higher than in Table 1), with only the VIX providing some additional explanatory power (column 6; the regression results with the other variables are not reported).
- Considering country factors, Table 3 shows that the presence of capital controls as well as low quality institutions is associated with a lower level of cross-border banking flows. Similarly, more restrictions on foreign bank entry reduce the level of cross-border change in claims on both banks and non-banks.

The interactions of country characteristics with global liquidity show that a more flexible exchange rate regime reduces the cyclicality of change in claims on banks, and that stricter capital controls reduces the cyclicality of change in claims on non-banks borrowers (see Table 3). For the bank regulatory measures, greater capital stringency and/or more supervision power reduce the cyclicality with respect to global liquidity of claims on banks, but not that of claims on non-banks. More restrictions on foreign bank entry lower in general the cycle role of the global liquidity factor.

Table 1 - Evolution of cross-border claims to banks and no-banks during 1996Q1-2012Q4

Panel A - Dependent Variable: Log Changes in BIS Locational Cross-Border Claims on Banks (in %)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
GDP Growth (lag)	0.360***	0.307***	0.374***	0.234***	0.292***	0.335***	0.294***	0.363***	0.227***	0.237***
	(0.0580)	(0.0544)	(0.0589)	(0.0573)	(0.0705)	(0.0598)	(0.0613)	(0.0567)	(0.0579)	(0.0695)
Inflation (lag)	-0.116***	-0.0922***	-0.109***	-0.138***	-0.152***	-0.134***	-0.136***	-0.112***	-0.116***	-0.0995***
	(0.0288)	(0.0274)	(0.0297)	(0.0306)	(0.0414)	(0.0292)	(0.0265)	(0.0288)	(0.0290)	(0.0366)
Change in Interest rate Differential (Domestic rate - Fed Fund Rate)	-0.0593**	-0.0162	-0.0521*	-0.0791***	-0.0560	-0.0576**	-0.0556*	-0.0610*	-0.0402	-0.0279
	(0.0282)	(0.0283)	(0.0285)	(0.0272)	(0.0362)	(0.0275)	(0.0278)	(0.0304)	(0.0274)	(0.0315)
VIX		-0.190***							-0.129***	-0.105***
		(0.0250)							(0.0293)	(0.0289)
TED spread			-0.837*						-0.488	-1.584**
			(0.497)						(0.554)	(0.686)
Global Bank Leverage				0.390***					0.289***	0.404***
				(0.0743)					(0.0661)	(0.0524)
Credit Conditions in the US					-0.251***					0.279***
					(0.0854)					(0.0719)
Real Federal Funds Rate						0.274**			0.0278	-0.0451
						(0.103)			(0.115)	(0.132)
Slope of yield curve							-0.855***		-0.132	-0.536**
							(0.218)		(0.237)	(0.252)
G4 Countries M2 (Annual growth rate)								0.0920***	0.0238	0.0925**
								(0.0309)	(0.0252)	(0.0355)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	0.038	0.077	0.039	0.078	0.045	0.042	0.050	0.042	0.098	0.114
R-squared	42	42	42	42	42	42	42	42	42	42
Number of countries	2715	2715	2715	2715	2254	2715	2715	2715	2715	2254

Panel B - Dependent Variable: Log Changes in BIS Locational Cross-Border Claims on Non-Banks (in %)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
GDP Growth (lag)	0.276***	0.240***	0.285***	0.191***	0.237***	0.250***	0.227***	0.277***	0.183***	0.213***
	(0.0479)	(0.0460)	(0.0480)	(0.0382)	(0.0465)	(0.0478)	(0.0476)	(0.0469)	(0.0403)	(0.0437)
Inflation (lag)	-0.0484**	-0.0313	-0.0438*	-0.0645***	-0.0671**	-0.0661***	-0.0632***	-0.0466*	-0.0537***	-0.0326
	(0.0236)	(0.0210)	(0.0237)	(0.0212)	(0.0275)	(0.0235)	(0.0234)	(0.0231)	(0.0193)	(0.0251)
Change in Interest rate Differential (Domestic rate - Fed Fund Rate)	-0.0184	0.00941	-0.0140	-0.0314	-0.0140	-0.0174	-0.0163	-0.0190	-0.00463	0.0136
	(0.0339)	(0.0301)	(0.0342)	(0.0328)	(0.0317)	(0.0328)	(0.0323)	(0.0345)	(0.0304)	(0.0281)
VIX		-0.127***							-0.0912***	-0.0880***
		(0.0167)							(0.0231)	(0.0238)
TED spread			-0.507						-0.270	-0.747
			(0.319)						(0.466)	(0.453)
Global Bank Leverage				0.260***					0.179***	0.215***
				(0.0454)					(0.0442)	(0.0477)
Credit Conditions in the US					-0.195***					0.138**
					(0.0592)					(0.0651)
Real Federal Funds Rate						0.280***			0.155*	0.218**
						(0.0682)			(0.0829)	(0.105)
Slope of yield curve							-0.630***		0.0165	-0.0891
							(0.125)		(0.152)	(0.165)
G4 Countries M2 (Annual growth rate)								0.0462**	0.0124	0.0384*
								(0.0217)	(0.0201)	(0.0216)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,711	2,711	2,711	2,711	2,263	2,711	2,711	2,711	2,711	2,263
R-squared	0.042	0.081	0.043	0.081	0.056	0.051	0.056	0.044	0.104	0.117
Number of ifscode	42	42	42	42	42	42	42	42	42	42

Notes: Panel regressions with country fixed effects and standard errors clustered by country. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 2: Summary (PCA) Measure vs. Drivers of Cross-Border Banking Claims on Banks

Variables	(1)	(2)	(3)	(4)	(5)	(6)
GDP Growth (lag)	0.360***	0.168***	0.359***	0.167***	0.165***	0.182***
	(0.0580)	(0.0578)	(0.0698)	(0.0582)	(0.0579)	(0.0581)
Inflation (lag)	-0.116***	-0.153***	-0.136***	-0.154***	-0.154***	-0.110***
	(0.0288)	(0.0310)	(0.0391)	(0.0326)	(0.0319)	(0.0314)
Change in Interest rate Differential	-0.0593**	-0.0706*	-0.0544	-0.0698**	-0.0720*	-0.0229
(Domestic rate - Fed Fund Rate)	(0.0282)	(0.0351)	(0.0374)	(0.0344)	(0.0357)	(0.0324)
Global Cross-border Liquidity		2.544***		2.535***	2.401***	1.917***
(PCA_Quantity)		(0.359)		(0.347)	(0.371)	(0.387)
Global Cross-Border Liquidity			0.454*	0.0600		
(PCA_Prices)			(0.256)	(0.234)		
Global Bank Leverage					0.0339	
					(0.0703)	
VIX						-0.143***
						(0.0278)
Observations	2,715	2,254	2,254	2,254	2,254	2,254
R-squared	0.038	0.106	0.039	0.106	0.106	0.118
Number of countries	42	42	42	42	42	42

Notes: The table reports the estimates of panel regressions with country fixed effects and clustered standard errors at the borrower country level. The dependent variables are the change in cross-border claims on banks . *** indicate significance at 1 percent, ** at 5 percent, and * at 10 percent, respectively.

Table 3: Country specific variables, level and interacted with global liquidity coefficients

Variables	Cross-border banking claims on Banks		Cross-border banking claims on Non-Banks	
Exchange rate flexibility	0.329	0.263	-0.0364	0.0622
	(0.678)	(0.767)	(0.456)	(0.494)
Exchange rate flexibility*Global_CB_Liquidity		-0.630***		-0.196
		(0.146)		(0.125)
Capital controls	-0.0496**	-0.0384*	-0.0352**	-0.0226
	(0.0192)	(0.0191)	(0.0173)	(0.0171)
Capital controls*Global_CB_Liquidity		-0.0307		-0.0194**
		(0.0212)		(0.00903)
Institution quality 1/	-2.104***	-2.196***	-1.734***	-1.809***
	(0.546)	(0.615)	(0.462)	(0.512)
Institution quality*Global_CB_Liquidity		-0.312		-0.0239
		(0.243)		(0.149)
Capital stringency	-0.142	-0.123	0.0234	0.00882
	(0.145)	(0.153)	(0.192)	(0.191)
Capital stringency*Global_CB_Liquidity		-0.207***		-0.0484
		(0.0661)		(0.0604)
Supervisory power	-0.0334	-0.0322	0.118	0.125
	(0.295)	(0.297)	(0.169)	(0.172)
Supervisory power*Global_CB_Liquidity		-0.0936**		-0.00438
		(0.0381)		(0.0289)
Limits on foreign banks	-1.128***	1.883**	-0.819***	0.400
	(0.359)	(0.740)	(0.189)	(0.353)
Limits on foreign banks*Global_CB_Liquidity		-3.360***		-1.361***
		(0.607)		(0.395)

Notes: The table reports the estimates of panel regressions with country fixed effects and clustered standard errors at the borrower country level. The dependent variables are the change in cross-border claims on banks and non banks. The variables reported in the table were introduced individually (not all simultaneously). All regressions also include lag GDP growth, lag CPI inflation, change in interest rate differentials, and Global liquidity (PCA_Quantity), but they are not reported. *** indicate significance at 1 percent, ** at 5 percent, and * at 10 percent, respectively. 1/High values indicate lower institutional quality.

Annex IV. The Role of the International Asset Management Industry[1]

Both advanced and emerging economies have witnessed a strong growth in the asset management industry (Table 1). While real money managers do not typically use leverage in the proportions that banks do, their growing assets have nonetheless given them an increasingly important role in the global allocation of liquidity. Amid a trend toward professional management of discretionary household assets (Walter, 2011), their growth has partly been driven by a reallocation of portfolios away from domestic fixed income, seeking more diversification. This has been reflected in a decline in home bias (Solnik and Zuo (2013) and GFSR (2011)). Financial innovation in the form of new products and technological advances has also contributed to this expansion. More recently, banking sector deleveraging after the peak of global crisis, and a search for yield in a low-interest rate environment, have further contributed to shifting intermediation to capital markets.

Table 1. The Size of Global and Local Institutional Investors and Mutual Funds

(In trillions of U.S. dollars, unless otherwise indicated)

	1995	2000	2005	2007	2009	2011	2012
Assets under management of mutual funds and institutional investors							
Selected advanced economies 1/ 2/							
Total assets	22	35	53	68	65	70	76
Total in percent of GDP	96	143	159	179	172	167	180
Mutual funds	6	13	19	26	25	26	29
Of which							
Share of open-end funds in total mutual fund assets (in percent) 3/	94	97	96	97	97	97	97
Institutional investors	16	23	34	41	40	44	47
Share of institutional investors in total assets (in percent)	72	64	64	61	61	63	61
Selected emerging market and other economies 2/ 4/							
Total assets	...	...	2.3	4.4	4.8	6.4	...
Total in percent of GDP 5/	...	...	32	36	37	36	...
Mutual funds	...	...	0.8	1.9	1.9	2.3	...
Institutional investors	...	...	1.5	2.5	2.9	4.1	...
Share of institutional investors in total assets (in percent) 5/	...	...	65	59	60	62	...

Sources: OECD; World Bank, Global Development Finance database; IMF, International Financial Statistics; and IMF staff estimates.

1/ Including Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

2/ These data may reflect some double-counting of assets, such as those owned by defined contribution pensions funds and managed by investment companies.

3/ The data include Australia, Finland, France, Greece, Spain, the United Kingdom, and the United States.

4/ Including Argentina, Brazil, Chile, China, Colombia, Croatia, Czech Republic, Egypt, Hungary, India, Indonesia, Korea, Latvia, Malaysia, Mexico, Nigeria, Morocco, Peru, Philippines, Poland, Russia, South Africa, Sri Lanka, Thailand, Turkey, Uruguay, and Vietnam. China data starts in 2007.

5/ Excluding China.

[1] Prepared by Luis Brandao Marques, Pragyan Deb, Gaston Gelos, and Brenda González-Hermosillo (MCM)

Many emerging market economies have graduated to investment grade in recent years. This has also led to asset managers in advanced economies becoming more active in emerging markets (GFSR, April 2014). Insurance companies and pension funds in emerging market economies have also been relatively new players in global capital markets. While total assets under management in emerging economies are tiny relative to those in advanced economies, they have also grown significantly in recent years.

Concentration has been a common trend for the entire asset management industry since the global financial crisis. Contributing factors for this recent increase in concentration are economies of scale in portfolio management and administration and the prevalence of index-based strategies (Office of Financial Research, 2013). For most emerging markets, concentration among international mutual funds is still low but on the rise. Concentration of equity ownership in particular is generally low, with the notable exception of South Africa where it is moderate.

At the same time, the importance of the official sector in global asset allocation has also grown, through sovereign wealth funds (SWF) and management of international reserves. The stock of international reserves in a number of emerging economies has grown substantially, tripling since 2007 (for an assessment of reserve adequacy, see IMF, 2013e). Sovereign wealth funds have not only expanded substantially in size over the last decade but have also increasingly diversified their portfolios, including through investment in emerging markets. Moreover, several emerging market economies have recently launched their own SWF, also making investments abroad.

The role of asset management has been investigated in the finance literature to better understand the global allocation of funds. Market concentration in the asset management industry can contribute to increased transmission of global shocks to emerging markets by increasing the risk of fire sales and the transmission of firm-level risks. On the other hand, more concentration may also mean lower competitive pressures and smaller incentives for risk taking, reducing the role of these funds in the transmission of global liquidity. The complexity of the issue and the absence of an unambiguous impact has given rise to a variety of studies.

One area of research focuses on portfolio managers' incentives. Most fund managers are evaluated against standard benchmarks. Compensation of mutual fund managers is typically linked to the performance of their portfolios relative to benchmark indices, such as Morgan Stanley Capital International (MSCI) indices for equities in emerging markets and JP Morgan's Emerging Market Bond Indices (EMBI) indices for bonds (GFSR, April 2014). Among other things, this may create an incentive for fund managers to follow their peers. Compensation incentives can interact with wealth effects, changes in risk aversion, and portfolio constraints to explain contagion across countries even in the absence of fundamental linkages (Calvo and Mendoza, 2000, Broner et al., 2006, Chakravorti and Lall, 2004, Ilyina, 2005). For example, when global risk appetite declines, fund managers are more likely to retrench to their benchmarks.

Another thread links the growing role of institutional investors with increased commonalities. Large asset managers, together with index-related trading may have contributed to the increasing role of common factors in cross-border capital flow movements. Karolyi et al. (2012) show that

common factors are major drivers in countries with a greater presence of international investors, and have more correlated trading activity. This is in line with the evidence at the national level provided by Kamara, Lou, and Sadka (2008). Similarly, Koch, Ruenzi, and Starks (2009) show that stocks with higher mutual fund ownership exhibit greater commonality. As discussed in Karolyi and others (2012), the intuition is that growing institutional ownership may give rise to correlated trading across stocks, which, in turn, creates common buying or selling pressure, and thus higher levels of common variation.

Portfolio rebalancing effects are also at play in cross-border portfolio flows. The implications of portfolio rebalancing effects have been stressed in the theoretical literature on contagion and spillovers. In Kodres and Pritsker (2002), investors transmit idiosyncratic shocks from one market to others by rebalancing their portfolios' exposures to common macroeconomic risks. Kyle and Xiong (2001) model contagion as a wealth effect in a set up with two risky assets and different types of traders. Wealth effects as a source of contagion are also a feature of various other models, e.g. Goldstein and Pauzner (2004), Yuan (2002), and Pavlova and Rigobon (2007). Empirically, examining the stock allocations of approximately 6,500 international equity funds, Hau and Rey (2008) find strong support for portfolio rebalancing behavior aimed at stabilizing exchange rate risk and equity risk exposures around desired levels.[1]

[1] See Gelos (2011) for a survey of mutual fund behavior in EMs.

Annex V. Global Liquidity and Portfolio Capital Flows[1]

One of the channels through which global liquidity conditions can be transmitted internationally is through cross-border bond and equity portfolio flows. This section measures the impact of liquidity conditions in global financial centers (US, Europe and Japan) on portfolio flows to emerging markets (EM) and other advanced economies (AE). An overview of the data and the methodology used is discussed below.

1. Data

The analysis is based on mutual fund country flows from Emerging Portfolio Fund Research (EPFR) Global. Although EPFR data primarily captures the retail component of capital flows, it can serve a good proxy for the transmission of liquidity conditions trough the international portfolio flow channel because of the greater volatility of this component relative to institutional investor flows which tend to be more stable unless country ratings fall below the investment grade benchmark.[2] Since the coverage of the EPFR data expands over time, we normalize the data using assets under management (AUM) as the denominator. Monthly data on country level portfolio flows is available from 1996 in the case of equity flows and 2004 in the case of bond flows, albeit with limited coverage in the early period.

The proxies for liquidity indicators for the United States are sourced from the Federal Reserve Bank of Chicago's National Financial Conditions Index (NFCI). The liquidity variables contained in the NFCI are supplemented with other data sources when necessary (e.g. monetary policy variables, additional measures of term spreads etc.). Similar measures are also derived for other financial centers – United Kingdom, Euro Area and Japan.[3] The variables are standardized such that an increase in the value of the variable is associated with more ample liquidity.

The liquidity variables analyzed are organized into 5 bins based on type. These are: (i) price and term premia; (ii) quantity; (iii) volatility; (iv) credit; and (v) monetary policy. Table 1 below lists the variables used in the analysis.

Global and country level controls are added in the analysis. We use the S&P500 excess returns to control for a global factor and the International Country Risk Guide (ICRG) composite risk rating to control for country level financial, political and economic risk.

[1] Prepared by Luis Brandao Marques, Pragyan Deb, and Brenda Gonzalez-Hermosillo, (all MCM)

[2] See IMF Global Financial Stability Report (April 2014), Chapter 2, for a detailed discussion.

[3] We also include liquidity indictors for China, but these are not found to be significant in the presence of liquidity indicators from the financial centers.

Table 1. List of liquidity Indicators

Price	
United States	On-the-run vs Off-the-run 10-year Treasury liquidity premium 10-year/2-year Treasury yield spread 2-year/3-month Treasury yield spread 10-year/3-month Treasury yield spread 3-month Eurodollar spread (LIBID-Treasury) 3-month TED spread (LIBOR-Treasury)
United Kingdom	Overnight Sterling interbank rates (SONIA) 3-month GBP LIBOR spread (LIBOR-Gilt) 10-year/5-year UK Government Securities yield spread 10-year/3-months UK Government Securities yield spread 5-year/3-months UK Government Securities yield spread
Euro Area	3-month Euro LIBOR spread (LIBOR-Sovereign) 10-year/5-year EA AAA Sovereign yield spread 10-year/3-months EA AAA Sovereign yield spread 5-year/3-months EA AAA Sovereign yield spread
Japan	10-year/5-year Japanese Sovereign yield spread 10-year/3-months Japanese Sovereign yield spread 5-year/3-months Japanese Sovereign yield spread
Quantity	
United States	Change in Repo Market Volume Commercial Paper Outstanding Fixed Income Open Interest Equities Open Interest New US Corporate Debt Issuance New US Corporate Equity Issuance Broker-Dealer Leverage
United Kingdom	Net Share Issuance by UK residents Net Bond Issuance by UK residents Net Commercial Paper Issuance by UK residents
Euro Area	Net Share Issuance in EA Net securities (other than shares) Issuance in EA
Japan	Bond Issuance in Japan
Volatility	
Global	3-month Merrill Lynch Swaption Volatility Expectations (SMOVE) 1-month Merrill Lynch Swaption Volatility Expectations (MOVE) CBOE S&P 500 Volatility Index (VIX)

Credit	
United States	National Association of Credit Managers Index Growth in Consumer Credit Outstanding NFIB Credit Survey Growth in Commercial Bank Consumer Loans
United Kingdom	3-month growth in UK Business Lending 3-month growth in UK Mortgage Lending 3-month growth in UK Consumer Credit
Euro Area	3-month growth in loans to EA nonfinancial corporates 3-month growth in loans to EA Households
Japan	3-month growth in loans to Japanese corporations 3-month growth in loans to Japanese households
Monetary	
United States	Change in M2 Growth of M0 Shadow policy rate from Wu and Xia (2013) Federal Funds Rate
United Kingdom	Change in UK M4 DLN UK Base Rate UK Shadow Policy Rate by Wu and Xia (2013)
Euro Area	Change in EA M2 DLN EA Deposit facility rate ECB Shadow Policy Rate by Wu and Xia (2013)
Japan	Change in Japan M2 DLN Japanese Deposit facility rate

2. Empirical Specification

The first step is to rank variables within each bin to determine which liquidity variable has the largest explanatory power. The baseline model is a panel with country level fixed-effects and robust standard errors for each liquidity variable. That is,

$$f_{it} = \alpha_i + \gamma L_t + \beta_1 r_t^e + \beta_2 \Delta ICRG_{it-1} + u_{it}$$

where f_{it} is the bond or equity net flow to country i at month t, L_t is a measure of global liquidity (taken from Table 1), r_t^e is the S&P500's excess return over the US short term interest rate, and $ICRG_{it-1}$ is the Composite Risk Rating for country i at time t.

We run the models separately for EM and AE. All the variables are standardized and hence their coefficients can be compared directly. We rank the variables by the significance and size of their coefficients and R^2. We also perform out-of-sample estimates using a 3-month ahead mean square prediction error, with a rolling window of at least 3 years. The results are robust to alternate specifications (such as lags) and subsamples. In particular, we test for subsamples corresponding to the so called *"first phase"* of global liquidity (2003 to August 2008) and the *"second phase"* (September 2008 onwards); see Shin (2014).

Finally, we use the top ranked variable in each bin and perform a "horse race." That is, we test how much of bond and equity flows can be explained by the best performing liquidity variables.

3. Results

Local credit conditions and global portfolio investment flows have several global liquidity drivers in common. Most global liquidity variables which were found to be highly correlated with the commonality in credit conditions across countries are also significantly correlated with portfolio investment flows to EM and AE (Table 2). However, some variables which were only moderately correlated (e.g. the TED spread), or even weakly correlated with local credit conditions (such as VIX), are important drivers of portfolio flows. Monetary policy conditions, especially in the Euro area and in Japan, are also highly correlated with portfolio flows.

Table 2. Global Liquidity and Portfolio Investment Flows

	Bond Flows		Equity Flows	
	EM	AE	EM	AE
Price				
USA 10 year Off-the-run Liquidity Premium	0.230***	0.151***	0.087***	0.100***
3-month TED spread (LIBOR-Treasury)	0.498***	0.512***	0.094***	0.157***
US 10-year/2-year treasury spread	0.016	0.113***	-0.037**	-0.068***
EA 10-year/5-year AAA Sovereign yield spread	0.132***	0.252***	-0.044*	-0.061***
UK 10-year/5-year GSec yield spread	0.082***	0.224***	-0.005	-0.122***
JP 10-year/3-months Sovereign yield spread	0.145***	0.213***	0.205***	0.260***
Volatility				
CBOE S&P 500 Volatility Index (VIX)	0.328***	0.230***	0.198***	0.243***
Quantity				
Commercial Paper Outstanding	0.219***	0.143***	0.039*	0.127***
New US Corporate Debt Issuance 1/	0.163***	0.260***	0.030***	0.060***
New US Corporate Equity Issuance 1/	-0.013*	0.013	0.105***	0.057***
Net Share Issuance by UK residents 1/	-0.279***	-0.284***	-0.080***	-0.070***
US Broker Dealer Leverage	-0.061***	-0.247***	0.021*	0.119***
Credit				
US Credit Conditions Index	0.077***	0.188***	0.077**	0.230***
US Growth in Commercial Bank Loans	0.355***	0.380***	-0.003	-0.196***
UK 3-month growth in Consumer Credit	-0.021	-0.258***	0.032	0.200***
EA 3-month growth in loans to Households	0.147***	0.083***	0.086***	0.161***
EA 3-month growth in Loans to Nonfin. Corp.	-0.111***	-0.262***	0.002	0.007
Monetary				
USA Federal Funds Rate	0.064***	0.171***	-0.029	-0.068***
UK Base Rate	0.092***	0.289***	-0.019	-0.112***
EA Deposit facility rate	0.236***	0.398***	0.125***	0.098***
Japanese O/N Uncollaterized Call Rate	0.166***	0.323***	0.069**	0.153***

Note: The table shows the slope coefficient estimates of each global liquidity variable in a regression of mutual fund net flows (as a percent of assets under management) on global liquidity, the S&P 500 excess return, and the lagged value of the Composite Risk Rating of the International Country Risk Guide. Mutual fund data is from Emerging Portfolio Fund Research. All variables are standardized to allow comparison of coefficient estimates. Increases in the value of the variables are associated with more ample liquidity. Finally, *, **, *** signify statistical significance at the 10, 5, and 1 percent levels, respectively.

1/ Relative to a 12-month moving average.

When taken together, the association between global liquidity and portfolio investment is stronger for bond flows than for equity flows. While nearly a third the variation in bond flows can be explained by the liquidity variables, the corresponding figure for equity flows is less than a fifth (Table 3). Furthermore, for bond flows the highest ranked price and credit variable (TED spread and the growth in US commercial bank loans) have the largest explanatory power. In the case of equity flows, price and volatility variables (Japanese 10-year/3-months sovereign yield spread and the VIX) turn out to be more important.

Table 3. What Explains Portfolio Flows

Bond Flows

	Liquidity Variables					Controls			
	Price	*Volatility*	*Quantity*	*Credit*	*Monetary*	*S&P500*	*ICRG*	*Constant*	R^2
EM	0.4151***	0.0975***	0.0942***	0.3153***	-0.1593***	0.1544***	0.0462***	0.0117***	0.467
AE	0.2994***	0.0642***	0.0533***	0.2618***	0.0846*	0.1744***	0.0214	-0.0020***	0.465

Equity Flows

	Liquidity Variables					Controls			
	Price	*Volatility*	*Quantity*	*Credit*	*Monetary*	*S&P500*	*ICRG*	*Constant*	R^2
EM	0.2578***	0.2128***	-0.0125	-0.2266***	0.0814***	0.2790***	0.0435*	0.0266	0.233
AE	0.1514***	0.0984***	0.0314***	0.0551***	0.0493***	0.1343***	0.0171	-0.0167***	0.239

Note: The table shows the slope coefficient estimates of the best performing liquidity variables for each bin (based on Table 2) in a regression of mutual fund net flows (as a percent of assets under management) on global liquidity variables, the S&P 500 excess return, and the lagged value of the Composite Risk Rating of the International Country Risk Guide. Mutual fund data is from Emerging Portfolio Fund Research. All variables are standardized to allow comparison of coefficient estimates. Increases in the value of the variables are associated with more ample liquidity. ΔR^2 is the increase in R2 with the inclusion of the liquidity variables in the regression. Finally, *, **, *** signify statistical significance at the 10, 5, and 1 percent levels, respectively.

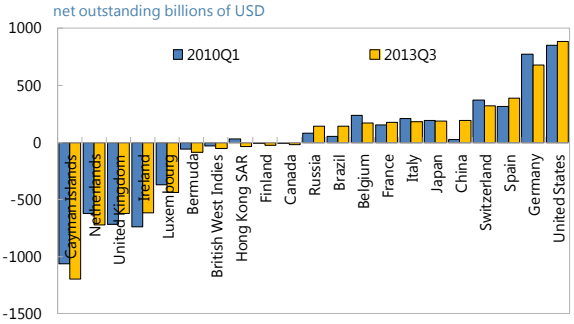
Annex VI. Off-Shore Debt Issuance: Recent Patterns[1]

Favorable funding market conditions in recent years have allowed more financial institutions and corporates to tap the international debt markets. As a result of strong demand for emerging market (EMs) products, risk premiums tightened and offshore debt issuance boomed especially in the context of emerging markets.

While the main suppliers and users of offshore debt issuance have generally remained the same, with advanced economies continuing to be the main users, the presence of EMs has been growing. BIS data shows that AEs' reliance on off-shore debt, which had surged in the immediate pre-crisis years, has since followed a steady decline, as EMs took up a larger share in the post-crisis period. Issuance out off-shore financial centers has thus not only stabilized, but even increased overall since 2010.

Suppliers and users of offshore debt 1/

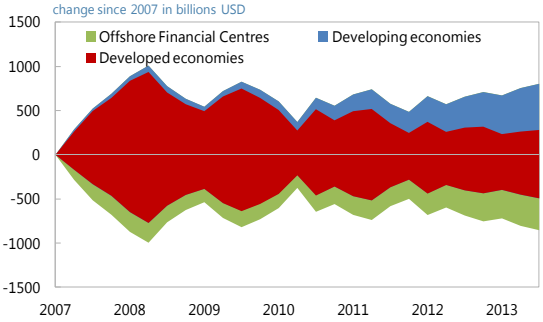
net outstanding billions of USD



Sources: BIS debt securities by nationality and residence
1/ As a difference of issuances by nationality and residence capturing offshore issuance of foreign incorporated subsidiaries.

The changing geography of offshore liquidity 1/

change since 2007 in billions USD



Sources: BIS debt securities by nationality and residence
1/ As a difference of issuances by nationality and residence capturing offshore issuance of foreign incorporated subsidiaries.

The increase in reliance on offshore debt markets has been the largest for China, with Brazil and Russia recording sizable increases in issuance as well. The debt issuance data by parent company sector in Dealogic and that by issuing company sector in the BIS debt statistics allows one to pin down issuers' sector in more detail. The boost in offshore debt from Chinese issuers is mostly attributed to non-banks, i.e. other financing vehicles in the public sector (e.g. oil and gas) as well as private sector NFCs (more than 50 percent of which related to real estate according to Dealogic), with public banks also taking up a noticeable share. Brazil is another case with high representation of OFIs having both public (i.e. oil and gas) and NFC parent companies. Equally important in Brazil is the substantial share of both private and public banks, with the latter also being the main contributor of the rise in total issuance in Russia. While public banks also play a dominant role in India, the shares of NFCs are large.

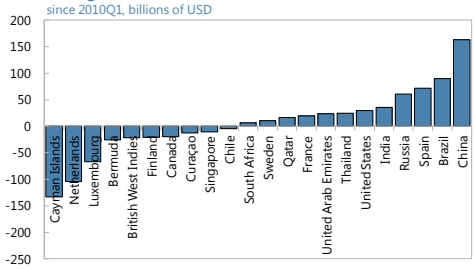
Aside from the foreign currency denominated debt issued onshore, offshore financing for the purpose of operation at home is sizable especially for China and Brazil. Balance of payment statistics broadly confirm that funds raised by offshore subsidiaries returned to parent companies in the form

[1] Prepared by Shuntaro Hara (SPR)

of reverse investment (i.e. FDI) increased in recent years. Unless such intercompany lending is included, currency mismatch risk may not be fully captured in external debt metrics.

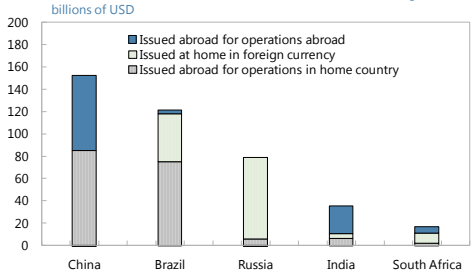
Chung et al. (2014) suggest that such offshore foreign currency borrowing by firms may turn up in corporate local currency deposits, making the case for monitoring

Change in offshore users 1/
since 2010Q1, billions of USD



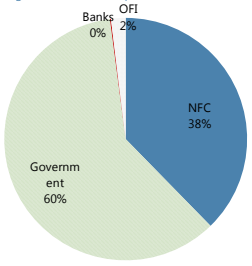
Sources: BIS debt securities by nationality and residence
1/ As a difference of issuances by nationality and residence capturing offshore issuance of foreign incorporated subsidiaries.

Breakdown of int. bond issuance since 2010Q1 1/
billions of USD



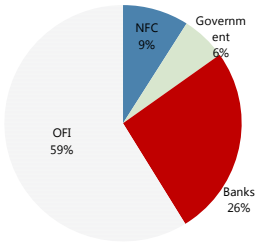
Sources: Dealogic and staff calculations
1/ Sum of the 3 categories. Net matured bonds. Not accounted for call options and amortization schedules.

China: by sector of parent company
Dealogic stock as of 2013q3, 155 billions of USD



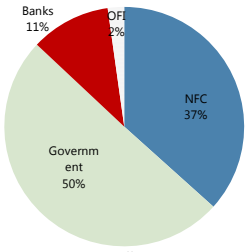
Sources: Dealogic and staff calculations
1/ Government includes state-owned corporates.

China: by sector of issuing company
BIS stock as of 2013q3, 240 billions of USD



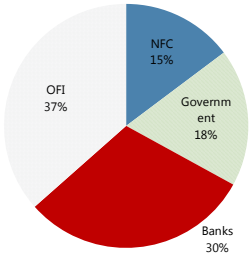
Sources: BIS debt securities by nationality

Brazil: by sector of parenty company
Dealogic stock as of 2013q3, 248 billlions of USD



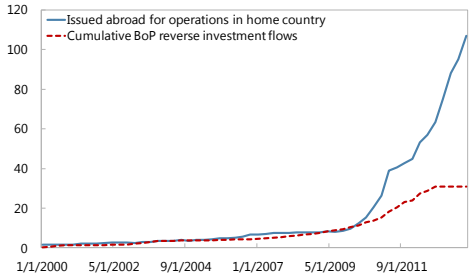
Sources: Dealogic and staff calculations
1/ Government includes state-owned corporates.

Brazil: by sector of issuing company
BIS stock as of 2013q3, 296 billions of USD



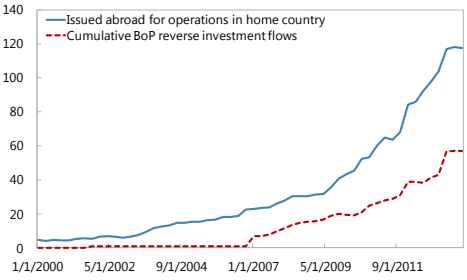
Sources: BIS debt securities by nationality

China: Comparison int. bond issuance and BoP statistics
billions of USD



Sources: IMF BoP working data, Dealogic and staff calculations

Brazil: Comparison int. bond issuance and BoP statistics
billions of USD



Sources: IMF BoP working data, Dealogic and staff calculations

Annex VII. Banks' Noncore Liabilities as Indicators of Financial Sector Vulnerability[1]

The role of banks' balance sheets in financial stability has garnered growing attention since the 2008 financial crisis. Recent literature, including Hahm, Shin & Shin (2012) explored the usefulness of banks' balance sheets in signaling financial vulnerabilities. Although the funding liquidity indicators used in this exercise are country specific, they offer a useful platform from which to explore global liquidity as indicators of financial vulnerability. This note updates the 2012 exercise, benefitting from an expanded time frame and additional macro control variables. Results suggest that noncore indicators are highly associated with different types of financial crises, although their predictive power for non-banking-related financial crises may be limited.

1. Background

The Hahm et al (2012) analysis used the IFS database to construct noncore indicators and assessed their predictive power over three types of financial crises. Based on data from the Fund's IFS database, banks' noncore liability indicators are based on two approaches: (1) Noncore 1: The sum of banks' liability to the foreign sector + (M3 – M2); and, (2) Noncore 2: The sum of banks' liabilities to the foreign sector + banks' liabilities to the non-banking financial sector. Using binary dummy variables to indicate crisis, the authors offered three definitions of crises to capture sharp currency depreciation, increases in market interest rates and declines in stock price indexes[2]. The exercise's time frame spanned from 2000 to the end of 2010, involving 202 countries, though data limitation reduced the number of countries to around 40 for most of the estimations.

Using panel probit models, the authors found that indicators of non-core bank liability have significant predictive power for currency and credit crises, though less so for stock market crises. Specifically, non-core liability ratios (as ratios to M1, M2, and "core" liability – the sum of demand deposits, time and savings deposits, foreign currency deposits and restricted deposits) are all significant at the 1 percent level. The decomposition of the two noncore indicators into their respective components – foreign liabilities, domestic nonbank liabilities and monetary aggregates (M3 – M2) suggested that foreign liabilities in particular play a robust role as a predictor of currency and credit crises. For stock market crises, banks' foreign borrowers are more important relative to

[1] Prepared by Sally Chen (SPR)

[2] (1) Currency – currency depreciation of more than 25 percent in one year and, depreciation is at least 10 percent more than the previous year;

(2) Credit – sharp increases in money market rates such that they reach the top 3 percent tail of the pooled in-sample distribution;

(3) Stock market crisis – changes in the stock market index falls to the bottom 3 percent tail of the pooled in-sample distribution.

other indicators, though even here, the indicator becomes insignificant, along with others, once the authors controlled for credit-to-GDP ratios.

2. An update

To update the exercise, we relied on the same construction as Hahm, Shin & Shin for noncore indicators. As Hahm et al had already investigated the usefulness of different noncore components, staff focused the analysis on the predictive power of noncore indicators. Noncore indicators used here are ratios of noncore 1 and noncore 2 liability levels to domestic nominal GDP. Because data are not available for all the noncore components for all the countries, both noncore indicators were used in the analysis to ensure broad coverage. In total, there are four noncore liquidity ratios in staff's analysis: noncore1 and noncore2-to-GDP ratios to assess the impact of noncore liquidity and, noncore1 and noncore2-to-M2 ratios to assess the impact of credit growth relative to trend.

The timeframe of coverage is extended, and control variables are added. The period covered expanded to include observations from 1980 to the first half of 2013. As a robustness check, in addition to crises indicators from the Hahm et al exercise, staff constructed additional crisis dummy variables using the Laeven & Valencia banking crisis database. All independent variables are lagged by two quarters.[1]

Country-specific and global factors are introduced as control variables to further assess the predictive power of noncore indicators. Domestic monetary conditions – proxied by policy target rates, domestic inflation and the 3-month-to-10-year sovereign bond yield spread – can affect the interest rate differentials between domestic and foreign interest rates and correspondingly, the incentives for carry trades. Meanwhile, fiscal stance – proxied by general government's primary balance as a share to GDP – can affect aggregate demand and thus the need for liquidity. The degree of liberalization of capital flows – proxied by the Chinn-Ito index of financial openness – may affect exchange rate levels and the size of capital crossing borders. Risk appetite affects the supply and demand of liquidity. Staff therefore included the VIX index a global factor in the analysis. Lastly, staff also introduced US noncore indicators as a proxy for global liquidity to assess whether liquidity conditions from the US supersedes local liquidity conditions. In line with the 2012 exercise, staff used a panel probit model with random effects to assed the predictive power of noncore indicators. As a robustness check against this approach, staff re-ran regressions using a conditional logit model with fixed effects. All results were qualitatively similar with the panel probit approach.

[1] Lag length selection is in line with the Hahm et al. (2012) exercise. Robustness checks with lag length ranging from 1 to 4 quarters offered qualitatively similar results.

The analysis focuses on large advanced and emerging market countries. Relative to the original Hahm et al exercise, which included 203 countries from the IFS database, there were 43 countries in the staff analysis, with a slightly different composition as new countries such as Argentina were added to the analysis, while others, mostly small countries from the original study, were excluded (Appendix 1).

Regression estimates suggests that noncore indicators are significant indicators of financial vulnerability, in line with conclusions from Hahm, Shin & Shin (2012). With the exception of credit crisis, the coefficients for noncore liquidity ratios are positive and most are significant at the 1 percent and 5 percent level. Such consistency suggests that an increase in the level of noncore liability relative to output and trend credit growth is highly correlated with increased probability of financial crises. And, noncore indicators' consistent predictive power across banking, stock market and currency crises underscores the important role banks play as intermediaries of financial transactions (Table 1). Meanwhile, there is no qualitative difference between predictive power between level ratios (noncore 1 and noncore 2 to GDP) and funding structure ratios (noncore 1 and noncore 2 to M2).

Table 1: Random Effects Panel Probit Results

	L&V Banking Crisis	Credit Crisis	Stock Market Crisis	Currency Crisis
Noncore 1/NGDP				
Coef.	0.25***	0.26	0.00**	1.47***
s.e.	(0.04)	(-0.46)	(0.00)	(0.57)
Pseudo R^2	0.04	0.01	0.02	0.11
Log Likelihood	-573.46	-16.98	-129.13	-101.18
# of observations	1,009	657	625	489
# of countries	19	20	20	17
Noncore 2/NGDP				
Coef.	0.33***	0.21	0.01**	6.55***
s.e.	(0.06)	(-0.38)	(0.00)	(1.84)
Pseudo R^2	0.04	0.00	0.03	0.20
Log Likelihood	-528.76	-31.15	-106.23	-74.22
# of observations	922	358	413	162
# of countries	19	11	13	6
Noncore1/M2				
Coef.	0.80***	-1.46	0.01**	1.28*
s.e.	(0.15)	(-1.93)	(0.01)	(0.71)
Pseudo R^2	0.02	0.01	0.02	0.11
Log Likelihood	-583.48	-16.94	-129.47	-101.07
# of observations	1,009	657	625	503
# of countries	19	20	20	17
Noncore 2/M2				
Coef.	2.06***	2.01**	0.01**	4.36***
s.e.	(0.32)	(-0.89)	(0.01)	(1.23)
Pseudo R^2	0.05	0.08	0.03	0.20
Log Likelihood	-479.86	-28.54	-107.25	-73.67
# of observations	850	317	413	162
# of countries	18	10	13	6

note: *** p<0.01, ** p<0.05, * p<0.1

Notably, for banking crises, noncore indicators remain significant even after controlling for country-specific and global factors. The association between the size of banks' liability and the likelihood of banking crisis is not surprising. Still, the indicators' consistent significance even after controlling financial cycle variables – inflation, policy rates, yield spreads and financial openness – underscores the important role banks' liability exposure plays in banking crises.

Other regression results, however, offer a more nuanced take on the role of noncore liquidity. While noncore liquidity has consistent, significant predicative power of banking crises, its significance in forecasting other types of crises, after controlling for domestic macro variables and global risk sentiment, becomes less clear. On their own, noncore liquidity ratios' predicative power for currency and stock market crises remain high (Table 1). However, these variables' significance diminished or disappeared once we controlled for country-specific macro variables and global risk appetite, suggesting that while increases in banks' noncore liquidity are associated with probabilities of different types of financial crises, their performance tends to be weak in predicting financial crises that are not directly related to the banking sector.

Noncore indicators' weak performance after controlling for macro variables implies that these indicators may not be capturing the causes of non-bank financial crises. And, the absence of consistent, significant explanatory variables in probit models associated with non-banking financial crises may be attributable, in large part, to the complex interplay of macro and financial variables as well as risk sentiment in triggering these types of crises.

The inclusion of "global liquidity" – proxied by US noncore liquidity – offered a mixed picture of the role global liquidity may have played in financial crises. For banking crises from the Laeven & Valencia database, the inclusion of global liquidity boosted the model's goodness of fit from an already-high 60 percent to 90 percent[1], while stripping statistical significance away from local liquidity indicators. As the banking crises database consists mostly of crises in advanced economies, with the bulk of these taking place in 2008, the near-perfect fit may have underscored the US-centric nature of the 2008 crisis and its US origin. Indeed, noncore indicators are highly correlated across large financial centers where the effect of the financial crisis was acute (Table 2). For other types of crises, the inclusion of US liquidity did not offer added benefits. Meanwhile, while risk sentiment, a proxy for global factor, was significant for banking and currency crisis (most at the1 percent level), it was not a significant predictor of stock market

Table 2: Correlation of noncore indicators below select large economies

	US noncore	UK noncore	France noncore	Germany noncore	Japan noncore
US noncore	1				
UK noncore	0.83	1			
France noncore	0.89	0.95	1		
Germany noncore	0.12	0.31	0.31	1	
Japan noncore	-0.67	-0.58	-0.81	-0.38	1

Note: US noncore is noncore 2; all others are noncore 1.
Source: Staff estimates

[1] US noncore indicators were only added to regressions with noncore 2 indicators as US data for noncore 1 indicators were not available. The limited number of observations for noncore2 may have also skewed regression results.

crises, suggesting that the cause and propagation of financial crises may be more idiosyncratic than expected.

3. Conclusion

This updated empirical analysis of the Hahm, Shin & Shin (2012) exposition of noncore liquidity indicators generally affirmed the usefulness of these indicators as a predictor of financial crises; the results are particularly strong for banking crises. While the weak performance of these indicators in currency, credit and stock market crises suggest that their broad use may be limited, it nonetheless suggests that noncore banking liability indicators can be useful complements to other liquidity indicators in assessing financial sector vulnerability.

Appendix 1. Countries, Indicator and Crisis Availability

Country	Noncore 1	Noncore 2	Banking Crisis [1]	Currency Crisis [2]	Credit Crisis [2]	Stock Mkt Crisis [2]
Argentina	x	x	o	o	o	o
Australia	x	x		o		
Austria	x	x	o			
Belgium	x	x	o			o
Brazil	x	x	o	o	o	o
Canada	x			o		o
China		x	o			
Cyprus		x				
Czech Republic	x			o		o
Denmark	x		o			o
Estonia						o
Euro Area	x					
Finland	x	x				o
France	x	x	o			o
Germany	x	x	o			
Greece	x	x	o			
Hong Kong SAR	x					
India	x				o	o
Indonesia			o	o	o	
Ireland	x	x	o			
Italy	x	x	o			o
Japan	x					o
Korea	x					
Luxembourg	x	x	o			
Malaysia	x					o
Malta				o		
Mexico	x			o		o
Netherlands	x	x	o			o
New Zealand	x			o		
Portugal	x	x	o			
Russia	x		o			
Saudi Arabia	x					
Singapore	x					
Slovak Republic						o
Slovenia			o			
South Africa	x	x		o		o
Spain		x	o			
Sweden	x	x	o	o		
Switzerland	x		o			
Thailand	x					o
Turkey	x		o	o	o	o
United Kingdom	x		o	o		o
United States		x	o			o

Annex VIII. Network Representation of Cross-Border Claims[1]

We explore the current network structure of cross-border claims on portfolio debt and equities as well as structure changes compared to the pre-crisis period.

The network structure is characterized by the relative size of bilateral claims and centrality of individual nodes, represented by relative thickness of links and size of nodes respectively. We calculate the relative thickness of links as the geometric average of the shares of each country pair's bilateral claims in each country's total claims:

$$\sqrt{\left[\frac{\left[Claim(A\to B)+Claim(B\to A)\right]}{2*Claim\left(A\to\sum_{i=B}^{N}I_i\right)}\right]*\left[\frac{\left[Claim(A\to B)+Claim(B\to A)\right]}{2*Claim\left(B\to\sum_{i=A}^{N}I_i\right)}\right]}$$

Where: $Claim(A\to B)$ represents country A's claim on country B

$Claim\left(A\to\sum_{i=B}^{N}I_i\right)$ represents country A's total claim

Node size is a function of the number of links and the size of the links that travel to the node. Hence a larger node represents higher centrality in a module.

Interpretation:

The United States, the United Kingdom, Euro area economies (e.g. France, Germany, but also Luxembourg), and Japan remain central in the current bond and equity portfolio networks. Japan, Singapore and Hong Kong serve as the financial centers connecting emerging Asia to the United States and Europe. Nordic (Sweden, Finland, Denmark and Norway) and Central European (e.g. Poland, Hungary, and Czech Republic) economies form strong linkages amongst themselves, and connect to the core Europe through Austria. Latin American economies have direct portfolio exposure with the United States, but bilateral claims within the region are relatively small.

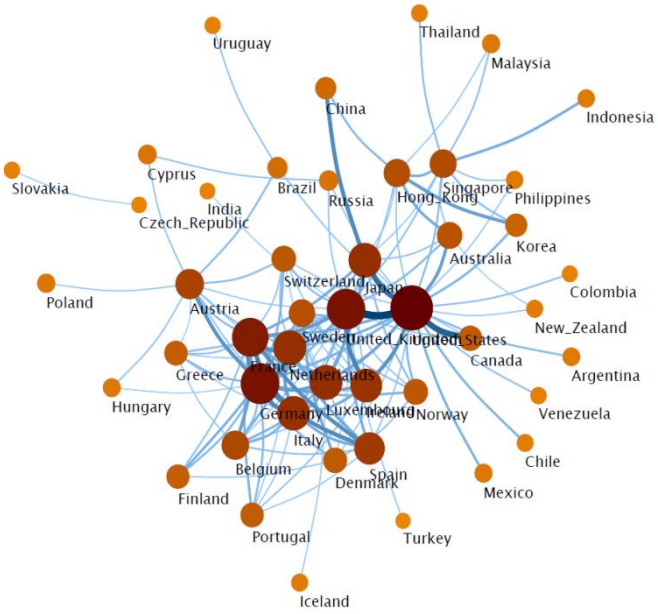
The network structure of cross-border debt and equity holdings is little changed between 2006Q4 and 2012Q4, notwithstanding the overall decline in magnitude of cross-border exposures post-crisis. Europe's portfolio linkages with the United States, largely through the United Kingdom, Germany and Luxembourg, have weakened since the crisis. Meanwhile, China's cross-border exposure with financial centers, e.g. Singapore and Hong Kong has increased significantly for both debt and equity

[1] Prepared by Yuanyan Sophia Zhang (SPR)

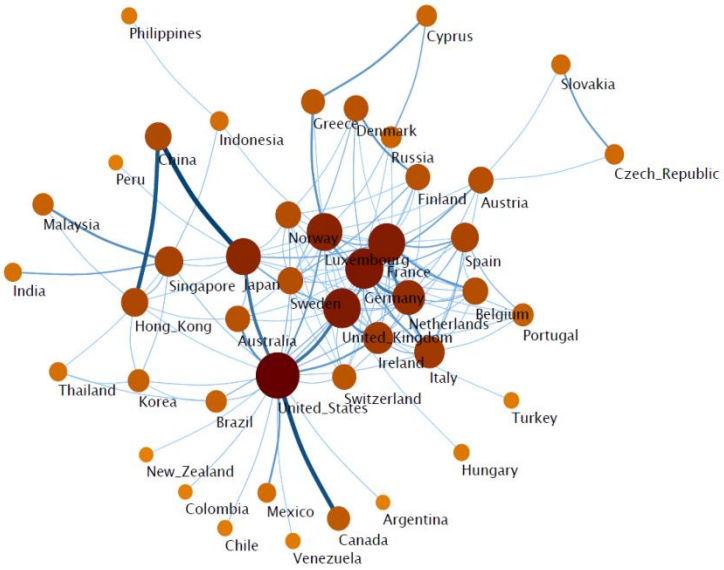
securities. The increased bilateral portfolio debt exposure between China and Hong Kong in part reflects the recent development of offshore debt issuance.

For readability of the network chart, only the top 10 percent strongest links are depicted

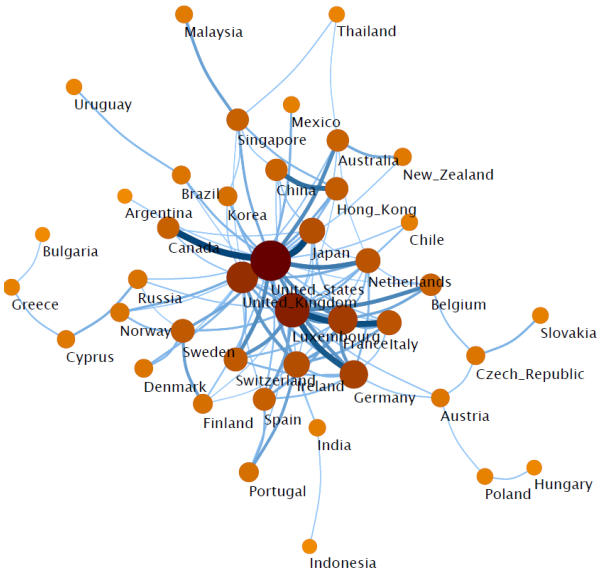
Portfolio Debt Bilateral Claims: 2006 Q4



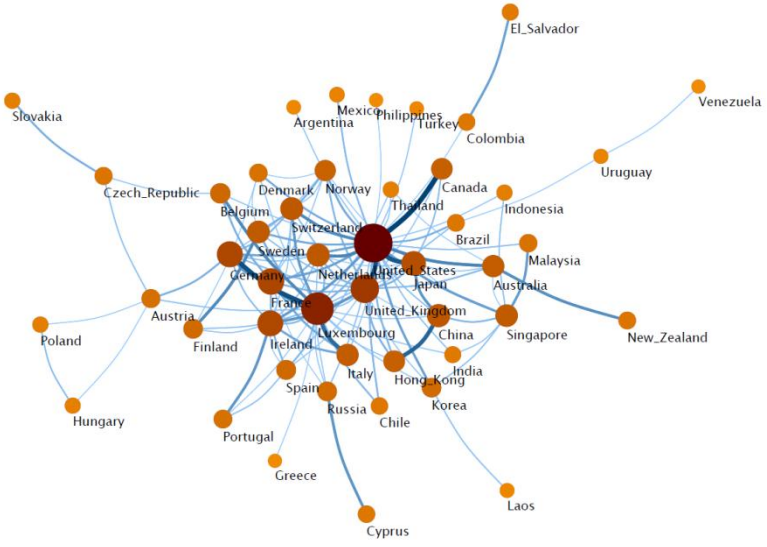
Portfolio Debt Bilateral Claims: 2012 Q4



Portfolio Equity Bilateral Claims: 2006 Q4



Portfolio Equity Bilateral Claims: 2012 Q4



Source: CPIS, 2012 Q4. Network map prepared by staff using the software from Rosvall and Bergstrom (2008).