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DILEMMA NOT TRILEMMA: THE GLOBAL FINANCIAL CYCLE AND MONETARY POLICY INDEPENDENCE

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Dilemma not Trilemma: The global Financial Cycle and Monetary Policy Independence
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ABSTRACT

There is a global financial cycle in capital flows, asset prices and in credit growth. This cycle comoves with the VIX, a measure of uncertainty and risk aversion of the markets. Asset markets in countries with more credit inflows are more sensitive to the global cycle. The global financial cycle is not aligned with countries' specific macroeconomic conditions. Symptoms can go from benign to large asset price bubbles and excess credit creation, which are among the best predictors of financial crises. A VAR analysis suggests that one of the determinants of the global financial cycle is monetary policy in the centre country, which affects leverage of global banks, capital flows and credit growth in the international financial system. Whenever capital is freely mobile, the global financial cycle constrains national monetary policies regardless of the exchange rate regime.

For the past few decades, international macroeconomics has postulated the "trilemma": with free capital mobility, independent monetary policies are feasible if and only if exchange rates are floating. The global financial cycle transforms the trilemma into a "dilemma" or an "irreconcilable duo": independent monetary policies are possible if and only if the capital account is managed.

So should policy restrict capital mobility? Gains to international capital flows have proved elusive whether in calibrated models or in the data. Large gross flows disrupt asset markets and financial intermediation, so the costs may be very large. To deal with the global financial cycle and the "dilemma", we have the following policy options: (a) targeted capital controls; (b) acting on one of the sources of the financial cycle itself, the monetary policy of the Fed and other main central banks; (c) acting on the transmission channel cyclically by limiting credit growth and leverage during the upturn of the cycle, using national macroprudential policies; (d) acting on the transmission channel structurally by imposing stricter limits on leverage for all financial intermediaries.

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Introduction

If one looks at the evolution of financial integration over the past half-century in the world economy, one might conclude that financial openness is an irresistible long run trend, hailed by policy makers and academic economists alike. Both emerging markets and advanced economies have increasingly opened their borders to financial flows. The scope for international capital flows to provide welfare gains or to do harm has widened considerably since the 1990s.

In international macroeconomics and finance we often think within the framework of the "trilemma": in a financially integrated world, fixed exchange rates export the monetary policy of the centre country to the periphery. The corollary is that if there are free capital flows, it is possible to have independent monetary policies only by having the exchange rate float; and conversely, that floating exchange rates enable monetary policy independence (see *e.g.* Obstfeld and Taylor (2004)). But does the scale of financial globalization and in particular the role of global banks put even this into question? Are the financing conditions set in the main world financing centres setting the tone for the rest of the world, regardless of the exchange-rate regime? Is there a global financial cycle and if yes, what are its determinants?

Risky asset prices around the globe, from stocks to corporate bonds, have a strong common component. So do capital flows. Credit flows are particularly procyclical and volatile. As credit cycles and capital flows obey global factors, they may be inappropriate for the cyclical conditions of many economies. For some countries, the global cycle can lead to excessive credit growth in boom times and excessive retrenchment in bad times. As the recent literature has confirmed, excessive credit growth is one of the best predictors of crisis (Gourinchas and Obstfeld (2012), Schularick and Taylor (2012)). Global financial cycles are associated with surges and retrenchments in capital flows, booms and busts in asset prices and crises. The picture emerging is that of a world with powerful global financial cycles characterised by large common movements in asset prices, gross flows and leverage. It is also a world with massive deviations from uncovered interest parity. There are interrelations with the monetary conditions of the centre country (the US), capital flows and the leverage of the financial sector in many parts of the international financial system. The global financial cycle can be related to monetary conditions in the centre country and to changes in risk aversion and uncertainty (Bekaert *et al.* (2012), Miranda Agrippino and Rey (2012), Bruno and Shin (2013b)).

But even if capital flows, especially credit flows, are largely driven by a global factor, they might still bring important benefits to the world economy. A brief review of the empirical evidence and the quantification of standard growth models, however, shows how elusive welfare gains to capital flows appear to be, though it could just be that they are hard to measure.

In part I, I describe the characteristics of capital flows (gross and net), show impressive co-movement in gross flows and discuss how they relate to global factors, as proxied in particular by the VIX. In part II, I show the existence of an important common factor in international asset prices, which is also closely related to the VIX. I conclude that there is a potent global financial cycle in gross capital flows, credit creation and asset prices, which has tight connections with fluctuations in uncertainty and risk aversion. Part III analyses the association of different types of capital flows with the global financial cycle and reinforces the conclusion that credit flows are particularly connected to the global financial cycle. In part IV, I hunt for the determinants of the global financial cycle itself and its transmission mechanism, focusing in particular on the role of monetary policy in the centre country, on the leverage of financial intermediaries, credit creation and credit flows. Part V argues that our findings invalidate the "trilemma" and lead to *a "dilemma", an "irreconcilable duo": independent monetary policies are possible if and only if the capital account is managed, directly or indirectly via macroprudential policies.* Part VI discusses briefly the findings of the literature on the gains to capital mobility.

I) The global financial cycle and international capital flows

A) Characteristics of international capital flows

Figure 1a presents a comprehensive heatmap of capital inflows by asset classes (FDI, portfolio equity, portfolio debt and credit[1]) into different geographical regions (North America, Western Europe, Central and Eastern Europe, Latin America, Asia, Emerging Asia, Africa[2]). The data are quarterly 1990Q1-2012Q4 and come from the IMF International Financial Statistics. The heatmap colours correspond to the signs of the correlations of capital flows across regions and types of flows (green when the correlation is positive and red otherwise). As evidenced by the very clear preponderance of the green colour in the heatmap, most types of capital inflows are positively correlated with one another and across regions. There is a very strong commonality in liability flows

[1] Technically we use "other investment" which contains bank loans and trade credit.
[2] For a precise list of the countries included, see Appendix A.

across the world. The only exception tends to be FDI inflows in all regions of the world with portfolio equity flows into Asia and some credit flows into Africa and into Asia. There are in particular strong positive correlations between all the major flows into North America and Western Europe.

The heatmap of capital outflows by asset classes (Figure 1b) into the same geographical regions shows an almost equally strong pattern of positive correlations. The only area for which capital outflows tend to be out of sync is Africa, and this is true across financial assets. Further, some FDI outflows out of Asia tend also to correlate negatively with other flows. Otherwise, the co-movement of flows is also very marked, in particular out of the main financial centres (North America and Western Europe) for credit, debt and portfolio equity.

On the other hand there are no systematic patterns in the heatmap of the correlations of net flows (Figure 1c). The commonality in flows is therefore a commonality in gross inflows and outflows and is particularly marked for Europe, the US - and also Latin America, Emerging Asia and Central and Eastern Europe - and somewhat less prevalent elsewhere in Asia and in Africa. In terms of types of assets, FDI does not seem highly correlated with other types of flows. A few questions spring to mind: does it matter if gross inflows and outflows follow a common pattern world wide if net flows do not? What are the characteristics of this global cycle? Do we see evidence of a cycle in asset prices and credit growth?

[Figures 1a,b,c here]

B) Co-movements with global factors

What is behind those co-movements in gross flows and are they associated with global credit growth and asset price fluctuations? It has long been noted that global factors are a major determinant of international capital flows. As observed by Calvo et al. (1996) "global factors affecting foreign investment tend to have an important cyclical component, which has given rise to repeated booms and busts in capital inflows". The literature has identified cycles in the real rate of interest and in the growth rate of advanced economies as important "push" factors for capital flows. More recently, several studies have found that movements in the VIX[3] are strongly associated with capital flows. The VIX is widely seen as a market proxy for risk aversion and uncertainty. The carry trade literature suggests that carry trade flows tend to increase when the VIX is low and to collapse when the VIX spikes. More recently, Forbes and Warnock (2012) and Bruno and Shin (2013a) emphasize the surge in capital flows associated with the lowering of the VIX.

[3] The VIX is the Chicago Board Options Exchange Market Volatility Index. It is a measure of the implied volatility of S&P 500 index options.

Figure 2 plots capital inflows disaggregated by asset types (FDI, portfolio equity, portfolio debt and credit) as a proportion of the world GDP for the period 1990Q1-2012Q4 and it reports the VIX (inverted scale) on the same graph. Particularly striking is the prolonged lowering of the VIX during the period 2002-2007, during which capital inflows surged. Flows tend to be highly correlated with one another and negatively correlated with the VIX (except FDI). Credit inflows and portfolio debt inflows show a high degree of co-movement over time (correlation of 0.52). Credit flows are the more volatile and procyclical component of all flows with a particularly dramatic surge in the run up to the crisis and an equally dramatic collapse during the crisis. Their correlation with the VIX (inverted scale) is 0.24 on the whole 1990Q1-2012Q4 sample (quarterly data).

[Figure 2 here]

In Table 1 (a), I present the correlations by regions of each type of inflows with the VIX. Capital inflows are negatively correlated with the VIX, even at a geographically disaggregated level. Overwhelmingly, during tranquil periods characterised by low VIX, when uncertainty and risk aversion are low, capital inflows are larger. In line with aggregate data, the only consistent exceptions are FDI inflows for which the correlation with the VIX is positive in all geographical areas. Credit flows into developed economies in Asia are also positively correlated with the VIX.

Table 1 (a): Unconditional correlations of liability flows with the VIX, quarterly, 1990Q1-2012Q4.

Correlations inflows / VIX	*North America*	*Latin America*	*Central Eastern Europe*	*Western Europe*	*Emerging Asia*	*Asia*	*Africa*
Equity	-0.03	-0.29	-0.34	-0.36	-0.11	-0.34	-0.23
FDI	0.09	0.23	0.10	0.09	0.08	0.17	0.06
Debt	-0.23	-0.17	-0.28	-0.16	-0.29	-0.08	-0.23
Credit	-0.22	-0.10	-0.14	-0.21	-0.24	0.06	-0.13

If I condition on other "push factors" (world short term real interest rate and world growth rate), a similar pattern emerges (see Table 1 (b)). The VIX is significantly negatively associated with fluctuations in capital inflows, except for FDI inflows. The results are similar with outflows, both for the unconditional and for the conditional correlations for the US and Western Europe; they are weaker for the other geographical areas. In contrast, and in agreement with our previous results,

the same pattern of correlations does not hold for net flows. I do not report these results due to space constraints.

Table 1 (b): Conditional correlations of liability flows with the VIX, quarterly, 1990Q1-2012Q4..

Correlations inflows / VIX	*North America*	*Latin America*	*Central Eastern Europe*	*Western Europe*	*Emerging Asia*	*Asia*	*Africa*
Equity	-0.06	-0.31	-0.32	-0.38	-0.08	-0.34	-0.25
FDI	0.10	0.35	0.07	0.06	0.08	0.16	0.07
Debt	-0.30	-0.15	-0.36	-0.23	-0.28	-0.06	-0.22
Credit	-0.29	-0.15	-0.16	-0.24	-0.26	0.09	-0.14

In Table 1(c), I investigate whether fluctuations in the VIX are also associated with changes in credit creation and leverage using various measures. We report the conditional correlations controlling again for the classic push factors (world growth rate and short term real rate). Following Forbes (2012), I measure leverage as the ratio of private credit by deposit money banks and other financial institutions to bank deposits, including demand, time and saving deposits in nonbanks. The precise definitions of leverage and domestic credit can be found in Appendix B.

Table 1(c) offers this striking finding: in all areas of the world, credit growth is negatively linked to the VIX. Correlations tend to be the strongest in North America and Western Europe. Leverage and leverage growth are also negatively related to the VIX in all the main financial centres (North America, Western Europe and Asia), which are the homes of the global banks. But the correlation is in contrast positive for leverage and leverage growth in Latin America, CEE and Africa.

Table 1 (c): Conditional correlations of credit and leverage measures with the VIX, quarterly data, 1990-2012. The conditioning variables are the world real short rate and the world growth rate.

Correlations credit / VIX	*North America*	*Latin America*	*Central Eastern Europe*	*Western Europe*	*Emerging Asia*	*Asia*	*Africa*

Domestic credit growth	-0.26	-0.14	-0.14	-0.11	-0.01	-0.30	0.01
Leverage	-0.17	0.05	0.30	-0.09	-0.12	-0.25	0.03
Leverage growth	-0.32	0.06	0.07	-0.21	-0.06	-0.31	0.01

To sum up, the data show (i) commonality in capital inflows – and outflows – across regions and types of assets (except for FDI flows and a subset of Asian and African flows). The commonality is particularly strong for credit and portfolio debt inflows (see Figures 1a,b) but is absent for net capital flows (Figure 1c); (ii) surges in gross capital flows in period of low volatility and decline in flows when the VIX goes up (with the exception of FDI flows); a large volatility and pro-cyclicality of credit flows (see Figure 2 and Tables 1a,b); (iii) increases in credit growth around the world in parallel with falls of the VIX (see Table 1c); (iv) increases in leverage and leverage growth in all the main financial centres when the VIX is low (see Table 1c).

As noted in Brunnermeier et al. (2012) and Shin (2012), credit flows grew at a very fast rate in the 2003–2007 pre-crisis period and collapsed during the financial crisis. The pattern of capital inflows and outflows follows a global financial cycle which is synchronized with fluctuations in world market risk aversion and uncertainty as proxied by the VIX. Furthermore, it appears that credit creation in the banking sector and leverage are dancing to the same tune.

II) The global financial cycle: The common component in risky asset prices.

Having established the existence of a global financial cycle for capital inflows and outflows, credit growth and leverage, it is natural to study fluctuations in asset prices and to see whether they also follow the global financial cycle. One might think that prices of equities around the world, prices of corporate bonds and of commodities reflect to a large extent continent specific, sector specific, country specific and company specific factors. But, as shown by Miranda-Agrippino and Rey (2012) using a large cross section of 858 risky asset prices distributed on the five continents, an important

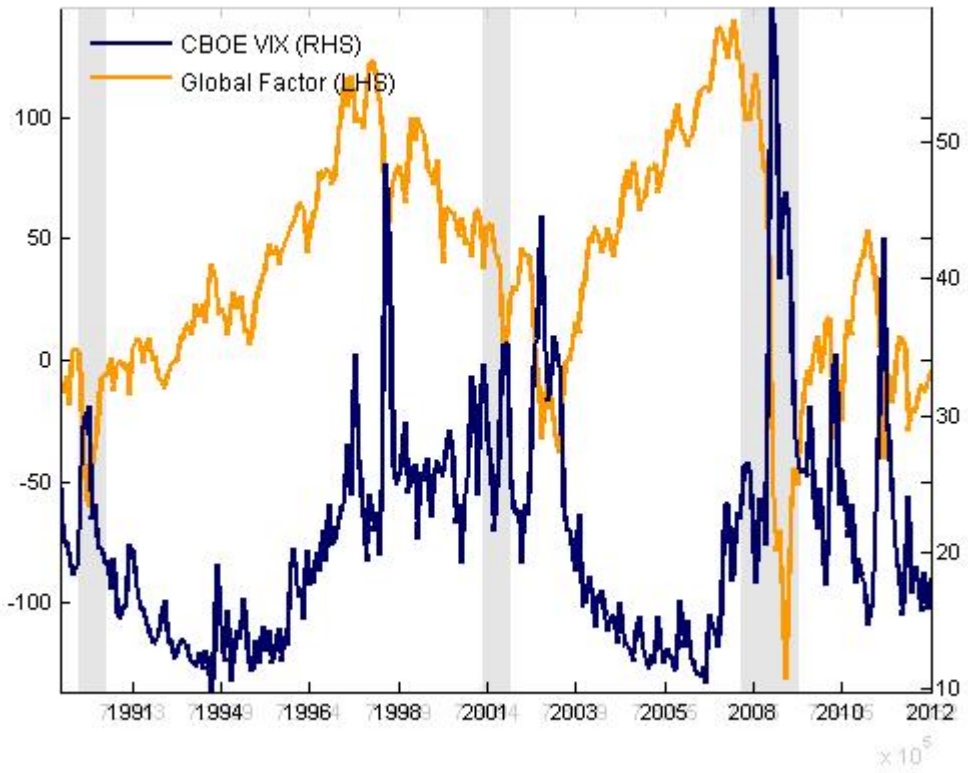
part of the variance of risky returns (25%) is explained by one single global factor[4]. This result is remarkable given the size and the heterogeneity of the set. Irrespective of the geographical location of the market in which the assets are traded or the specific asset class they belong to, risky returns load to a large extent on this global factor.

As apparent from Figure 3, taken from Miranda-Agrippino and Rey (2012), the factor is consistent with the timing of major events such as the Gulf War starting from the second half of 1990, 9/11 and the first quarter of 2009 when the most recent financial crisis reached its climax. Overall, the index goes up from the early 1990s until mid 1998 when the Russian crisis erupts followed by the LTCM bankruptcy, and eventually the bursting of the dotcom bubble. From the beginning of 2003, the index increases rapidly until the beginning of the third quarter of 2007. This is shortly after the collapse of the subprime market and coincides with the first signals of increased vulnerability of the financial markets. The high degree of correlation of the global factor with the VIX is striking. Building on the analyses of Adrian and Shin (2008) and Danielsson, Shin and Zygrand (2012), Miranda-Agrippino and Rey (2012) propose a structural interpretation of the factor. It can be understood as reflecting the joint evolution of the effective risk appetite of the market as well as realized market volatility. In turn the effective risk appetite of the market can be empirically related to the leverage of a subset of financial market intermediaries whose investment strategy is well approximated by a VaR constraint (broker dealer in the US, large European banks with significant trading operations and, more generally, banks classified in the "capital market" category in Bankscope[5]). Given that structural interpretation, it is not surprising that the factor should empirically be closely (negatively) correlated with the VIX. As pointed out in Brunnermeier et al. (2012) and Borio and Disyatat (2011), there is a positive feedback loop between greater credit supply, asset price inflation, and a compression of spreads. Smaller risk premiums amplify the credit boom. Measured risk is low and balance sheets look healthier as asset prices go up. By relaxing value-at-risk constraints, this creates additional space for lending and for credit, and so on. This mechanism is an important positive feedback loop between credit creation and risk spreads. It contributes to the procyclicality of credit flows and their importance in the build-up of financial fragility.

Figure 3: Global factor and VIX. Source: Miranda-Agrippino and Rey (2012).

[4] For a similar conclusion based on a dynamic factor analysis in the context of sovereign credit risk, see Longstaff et al. (2011)

[5] See Miranda-Agrippino and Rey (2012) for details.



To sum up, we have now established in flow data (across most types of flows and regions, but with some exceptions) and in price data (across a sectorally and geographically wide cross-section of risky asset prices) the existence of a global financial cycle. Interestingly, the VIX is a powerful index of the global financial cycle, whether for flows or for returns. Our analysis so far emphasizes striking correlations and patterns, but cannot address causality issues. Low value of the VIX, in particular for long periods of time, are associated with a build up of the global financial cycle: more capital inflows and outflows, more credit creation, more leverage and higher asset price inflation.

III) Capital flows and market sensitivities to the global financial cycle

In this part I attempt to gauge further the importance of the global financial cycle for different asset markets (stock prices, house prices) as well as for the leverage of financial intermediaries. Having reported the importance of the global cycle for the fluctuations of these variables in the time series dimension, I study in more details the factors affecting the cross sectional sensitivities of these variables to the global financial cycles. More precisely, I focus here on the possibility that larger volumes and different types of capital flows matter for the sensitivity of national markets to the global factor.

I investigate whether cross-sectionally, the sensitivities of country specific variables to the global factor VIX_t (logged) can be related to different types and intensities of capital flows into each market. The country specific variables $c_{i,t}$ are stock market returns $s_{i,t}$, banking sector leverage growth $lv_{i,t}$, and house price inflation $h_{i,t}$. I run the following set of regressions:

$$c_{i,t} = \alpha_i + \beta\, VIX_t + \delta \Delta VIX_t + \gamma * fl_{it} * VIX_t + \eta * fl_{it-1} * VIX_{t-1} + X_{it-1} + \varepsilon_{it}$$

where fl_{it} denotes flows into country i (inflows, outflows, different types of flows) normalized by the GDP of country i, X_{it} is a vector of control variables (lagged GDP growth of country i and lagged nominal effective exchange rate of country i). I also include ΔVIX_t, the change in the global factor. The interaction terms $fl_{it} * VIX_t$ and $fl_{it-1} * VIX_{t-1}$ are meant to capture the possible heterogeneous sensitivity of a given market to the global financial cycle depending on the intensity and types of capital flows it receives or exports. I run fixed effects estimators with clustered standard errors by country and include a linear time trend. We checked the stationarity of variables using a Pesaran test. We have a large number of observations (between 2770 and 3462 depending on the specification). Table 2 reports the results of selected specifications. Panel (a) reports our results for stock market returns (log difference of local stock market indices), Appendix C presents results for 2(b) banking sector leverage growth (difference of leverage ratio) and for 2(c) for house price inflation (log difference of property price indices).

Table 2 (a) Stock market returns $s_{i,t}$ is the dependent variable (1990-2013)							
fl_{it}	Credit L	C.nonbank L	Credit A	Debt L	Debt A	Equity L	Equity A
VIX_t	-0.0952*** (-12.64)	-0.0914*** (-12.78)	-0.0951*** (-12.25)	-0.0952*** (-12.66)	-0.0962*** (-12.34)	-0.0959*** (-11.96)	-0.0995*** (-12.94)
ΔVIX_t	-0.1743*** (-15.14)	-0.1669*** (-16.61)	-0.1759*** (-14.71)	-0.1737*** (-14.81)	-0.1751*** (-14.54)	-0.1758*** (-15.51)	-0.1744*** (-13.39)
fl_{it} *VIX_t	0.00 (-0.02)	0.0042 (1.17)	0.0002 (0.99)	0.0025* (1.98)	0.0006*** (3.54)	0.0010*** (6.63)	0.0016*** (3.2)
fl_{it-1} *VIX_{t-1}	-0.0007* (-1.88)	-0.0012** (-2.13)	-0.0004*** (-5.61)	-0.0005* (-1.77)	0.0006** (2.4)	0 (-0.55)	0.0001 (0.26)
Adj. R2	0.24	0.222	0.234	0.239	0.245	0.254	0.255
N	3042	3267	3073	2924	2971	2631	2770

Fixed effect estimator, standard errors adjusted for clustering on country, t-stat in parentheses. All specifications include the control variables and a linear time trend. Each column corresponds to a different specification of the flow in the interacted term.

Panel (a) shows that stock prices are significantly negatively related to the global factor (the VIX) and to its growth rate. Credit flows into and out of country i tend to be associated with a higher sensitivity of the stock market of country i to the global financial cycle (the interaction term is significantly negative). But, interestingly, debt outflows and especially equity inflows and outflows tend to be associated with a lesser sensitivity to the global cycle (interaction term positive). So cross-sectionally, just like in the time series, credit flows seem more strongly related to the global cycle than other flows and in particular than equity flows.

As can be seen in Appendix C, the results for banks leverage (b) and house prices (c) are similar in some respect. There is a negative correlation of banks leverage and house price inflation with the VIX and a positive correlation with the growth rate of the VIX. There is however in this specification no sign of any flows associated with a higher sensitivity of leverage of banks (or of house prices) to the global financial cycle (the interaction term is never significant).

Once again, it is worth emphasizing that these regressions indicate correlations and not causality. In the time series credit flows are very procyclical. In the cross section, credit flows tend to be associated with a stronger correlation of stock market returns with the global cycle, while equity flows tend to be associated with a weaker correlation[6].

IV) Monetary policy, capital flows and the global financial cycle

A) Recursive VAR analysis

The global financial cycle appears in co-movements of gross flows, asset prices, leverage and credit creation, which are all closely linked to fluctuations in the VIX. But what are its drivers?

Given the strong pro-cyclicality of credit flows and the way global banks operate (*e.g.* Shin (2012) and Bruno and Shin (2013a)) it is natural to investigate the effect on the global financial cycle of refinancing costs in dollars, i.e. Federal Reserve monetary policy (see Rajan (2006); Borio and Zhu (2008)). Shin (2012) describes how European global banks in particular were major actors in channelling US dollar liquidity worldwide before the crisis. Foreign bank branches in the US were raising large quantities of funds in dollars and transferring them to overseas markets. European

[6] It would of course be interesting to establish a causal link between cross-border credit flows and sensitivity to the cycle. But for this we would need instrumental variables.

global banks were not only intermediating savings back in the US market but were also serving Asian, Latin American, African and Middle Eastern markets. I will therefore treat the leverage of European banks as a key variable of the analysis. The dollar is the main currency of global banking. Since surges in capital flows - especially credit flows - are associated with increases in leverage worldwide, a natural interpretation is that monetary conditions in the centre country are transmitted world-wide through these cross-border gross credit flows. It is therefore those gross flows that should be tracked in order to assess financial fragility and overall credit conditions, as emphasized by Borio and Disyatat (2011), Gourinchas, Truempler and Rey (2012) and Obstfeld (2012). It is also only by looking at gross flows that one can keep track of currency and maturity mismatch on balance sheets of financial intermediaries and households. Both of these mismatches are well known contributors to financial instability.
This is of course not to say that net flows are irrelevant: current account imbalances are key for the long-run sustainability of the net external asset position, as a long literature shows (recently surveyed in Gourinchas and Rey (2013)).

To analyze the dynamic interaction between monetary policy, risk aversion and uncertainty, leverage and credit flows, I perform a recursive VAR analysis [7]. I build on the study of Bekaert, Hoerova and Lo Duca (2012). They show that movements in the federal funds rate have an effect on uncertainty (expected stock market volatility) and risk aversion, two components they extract from the VIX. Like them, I focus on the dynamic links between the federal funds rate and the VIX but I also study their dynamic interrelations with credit creation, leverage and credit flows. I use quarterly data for the period 1990-2012. I impose contemporaneous restrictions (Cholesky) on the responses of the variables, based on institutional knowledge. I order the variables such that the first variable cannot respond to contemporaneous shocks (within the quarter) of any other variables , the second one can respond to contemporaneous shocks affecting variable 1 but not any others etc…
I assume that GDP and prices respond with a lag as they are slow moving, while the global factor (VIX) can respond contemporaneously to any variable (and is therefore ordered last). The effective Fed Funds rate (FFR) is our penultimate variable: it can respond to any variable within the quarter except to the VIX. Financial variables such as credit, flows and leverage are in between: leverage is ordered immediately before the FFR . I include the following 7 variables (in this order): US GDP, US GDP deflator (GDPDEF), global credit (logged)(CREDIT) , global credit inflows (INFLOWS) , European

[7] The analysis borrows from Miranda Agrippino and Rey (2012) who provides a more detailed exercise disentangling effects on market effective risk aversion and volatility. Bruno and Shin (2013b) present a similarly inspired and independently developed analysis but they focus on the dynamic relation with the dollar exchange rate and the overshooting puzzle.

banks leverage (defined as the median of EU bank leverage) (EULEV), Fed Funds target rate (FFR) and VIX (logged). [8]

I note that since we are first and foremost interested in the impact of the shocks in the last three variables in the VAR (VIX, FFR and leverage), how the other variables are ordered makes no difference for those three shocks (all I need is partial identification) . For example, given a FFR shock both credit and flows will stay put in the first quarter and then are free to react, so the relative order of those two does not matter to FFR. That order only matters in between the two, because I am assuming that if there were a shock on cross border flows, global credit would take a quarter to react to that, but I am not focusing on this.

I use a two lag VAR, using the usual criteria (BIC and LR). Bootstrapped confidence intervals are computed using 1000 replications; light and dark grey shaded areas correspond to 95 and 86% confidence intervals respectively. I report a subset of key impulse responses in the text (Figure 4a and 4b). The complete set of impulse response functions are reported in Figure 5 in the Appendix.

Our key findings are the following:

(i) An increase in the effective federal funds rate (FFR) leads to an increase in the VIX after about 5 quarters and until 11 quarters. (Figure4a)

(ii) An increase in the VIX leads to a fall in European banks leverage. (Figure 4b)

(iii) A fall in the VIX leads to an increase in cross border credit flows up to 6 quarters. (Figure 4b)

(iv) An increase in the VIX leads to a fall in global domestic credit from 4 quarters onwards. (Figure 4b)

(v) An increase in the VIX leads to decline in the FFR. (Figure 4b)

(vi) An increase in the FFR leads to a fall in EU bank leverage after 15 quarters. (Figure 5)

(vii) An increase in the FFR leads to a fall in gross credit flows after 12 quarters. (Figure 5)

(viii) An increase in EU banks leverage is associated with an increase in domestic credit from a 1 quarter horizon. (Figure 5)

(ix) An increase in EU banks leverage is associated with a fall in the VIX after about 8 quarters. (Figure 5)

[8] See Appendix B for the precise definitions of the variables.

The VAR results are therefore consistent with the following interpretation. When the Federal Funds rate goes down, the VIX falls (after about 5 quarters), European banks' leverage rises, as do gross credit flows (after 12 quarters). A fall in the VIX leads to an increase in global domestic credit after 4 quarters.

Furthermore I find that increased bank leverage and capital flows, as well as credit expansion (though for credit it is only marginally significant) are associated with a subsequent fall in the VIX index. This is consistent with the following mechanism: as credit and capital flows go up, spreads fall: as noted in particular by Adrian and Shin (2010), the quasi-constancy of risk-weighted assets in the balance sheet of global banks (mostly the banks having large capital market divisions) at times when the unweighted volume of assets rises substantially suggests a fall in measured risk during expansion times. When leverage is high and credit is abundant, spreads are compressed and measured risk is low. This translates into a decline in the VIX. There is therefore a positive feedback loop between loose monetary policy, fall in the VIX, rise in credit, capital flows and leverage and further fall in the VIX[9].

From Figure 5, I also note that an increase in the VIX has a significant negative effect on GDP (as in Bloom (2009)) and on the GDP deflator. As expected, an increase in the FFR rate has a dampening effect on prices. I also note that monetary policy loosens when the VIX goes up (Figure 4b).

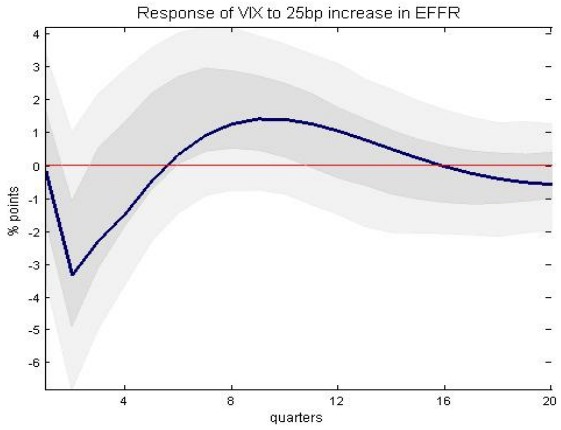


Figure 4a: 25 bp increase to the effective federal funds rate.

[9] This interpretation accords well with the micro studies of Jimenez, Ongena, Peydro and Saurina (2012) on European data who finds that banks grants more loans to riskier firms in a low interest rate environment and of Dell'Ariccia, Laeven and Suarez (2013) who have similar findings using US data.

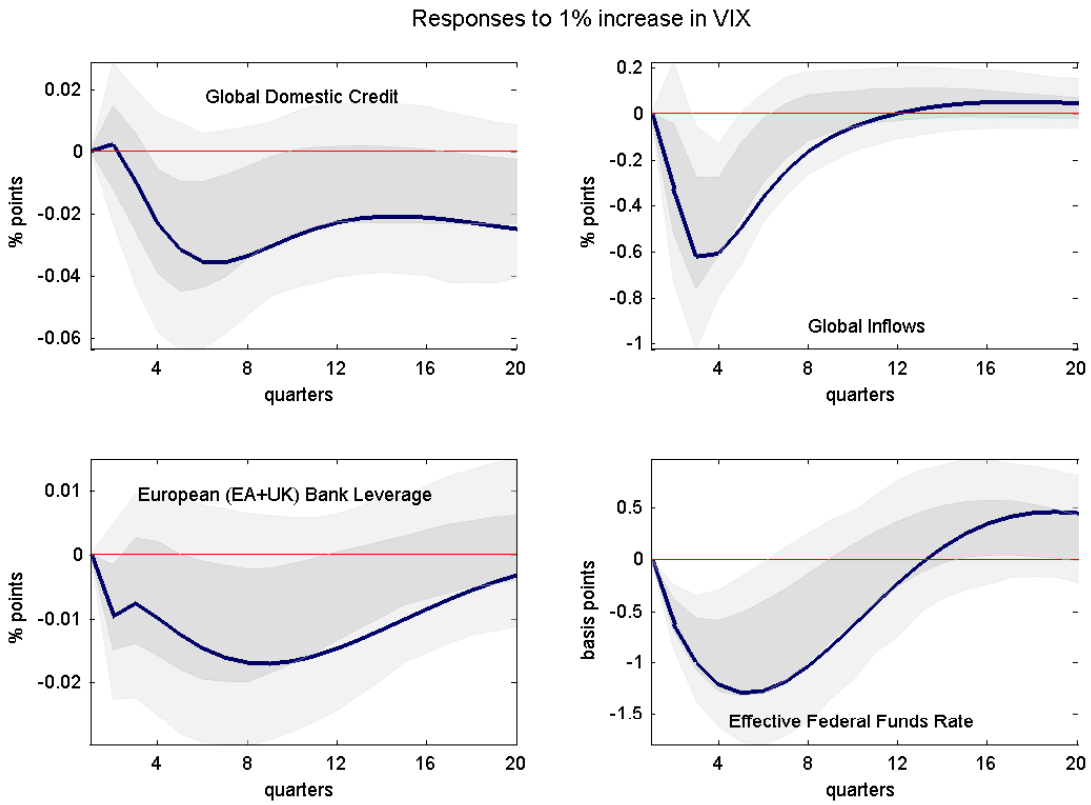


Figure 4b: Responses to a 1% increase in the VIX.

B) Robustness

I check robustness on the pre-crisis sample 1990-2007. I also check robustness by dropping some of our variables (I drop successively credit, leverage, flows one by one) and by dropping a lag to make sure overfitting is not an issue. Importantly, two studies with a different focus but some related results (Bekaert et al. (2012) and Bruno and Shin (2013b), allow us to assess further the robustness of some of the findings.

Bekaert et al. (2012) decompose the VIX index into a component reflecting expected stock market volatility and into a variance premium reflecting risk aversion. They run a structural four variable VAR with a business cycle indicator, the two components of the VIX and the US short-term real rate (defined as the Fed Funds end-of-month target rate minus the CPI annual inflation rate) as their benchmark. They find that a loose monetary policy reduces risk aversion and uncertainty; and that periods of high VIX are followed by looser monetary policy. They provide numerous robustness checks, in particular with respect to the measurement of monetary policy shocks and by comparing results on the pre-crisis sample and the whole sample. Their findings are compatible with my results showing an increase in the VIX following a tightening in the FFR and a loosening of monetary policy after a VIX increase (see Figure 4a,b).

Bruno and Shin (2013b) runs a 4 variable recursive VAR with FFR, log VIX, leverage and the real effective dollar exchange rate on quarterly data for the period 1995-2007. For monetary policy measures they use the real FFR and the real effective FFR, growth of US M1, and the residual of a Taylor rule. They use US broker dealer leverage instead of the broader measure of EU leverage. They find that a positive monetary policy shock leads to an increase in the VIX after quarter 4; to a decline in US broker-dealer leverage after about 10 quarters; an increase in the VIX leads to a decline in US broker-dealer leverage after quarter 10. These results are compatible with my results (i), (vi), (ii) with some differences in timing. The authors also find, after augmenting their VAR, that an increase in the FFR reduces credit flows (in their case defined as the first difference of US dollar liabilities of banks located outside the US) after about 7 quarters; that an increase in the VIX reduces flows . These additional results are also compatible with mine (see (vii), (iii)) with some differences in timing. Bruno and Shin (2013b) present in addition very interesting evidence on the dollar real effective exchange rate dynamics and the delayed overshooting puzzle.

C) Economic significance of the results

Are the shocks to the federal funds rate an important source of variation for the dynamics of the global financial cycle, indexed by the VIX?

In their 4 variable VAR, Bruno and Shin (2013b) find that shocks to the FFR explain almost 30% of the variance of the VIX at horizons longer than 10 quarters.

Similarly in their 4 variable structural VAR model, Bekaert et al (2012) find that monetary policy shocks account for over 20% of the variance of risk aversion at horizons longer than 7 quarters. They also account for a comparable part of the variance of uncertainty. In their six variable VAR, the monetary policy shock accounts for about 12% of the variance of risk aversion at horizons longer than 10 quarters.

Depending on the exact specification of the VAR analysis, I find that shocks to the FFR explain from about 4% of the variance of the VIX (in the 7 variable VAR on the whole 1990-2012 sample) to about 10% (in a 4 variable VAR on the 1990-2007 sample). That number goes up to 17% if I use, like Bruno and Shin (2013b) US broker-dealer leverage instead of the EU bank leverage variable.

Although there is some variance in the estimates depending on the number of variables and the exact specification of the VAR, these are economically significant, possibly large effects.

V) Taking stock: monetary conditions, capital flows and the global financial cycle

There is a global financial cycle in capital flows, asset prices and in credit growth. This cycle co-moves with the VIX, a measure of uncertainty and risk aversion of the markets. Asset markets with more credit inflows tend to be more sensitive to the global cycle. The global financial cycle is not aligned with countries' specific macroeconomic conditions. In a number of countries, this can lead to excess credit growth (or alternatively to monetary conditions which are too tight). Excess credit growth is one of the best predictors of crisis. Gourinchas and Obstfeld (2012) show that across all types of crisis, three variables play a statistically and economically significant role: the ratio of domestic credit to output, the real exchange rate, and the ratio of official reserves to output. Schularick and Taylor (2012) demonstrate that credit growth is a powerful predictor of financial crises, suggesting that such crises are "credit booms gone wrong" and that "policymakers ignore credit at their peril." Similar findings are echoed in Lund-Jensen (2012), who finds that high asset price inflation is associated with systemic banking crises. Our analysis clearly implies that gross flows (particularly credit and debt) should be monitored closely (in parallel with net flows which are key for sustainability issues) in order to assess financial fragility and overall credit conditions. It is also only by looking at gross flows and gross cross-border positions (the entire balance sheet of countries) that one can keep track of currency and maturity mismatch. Both of these mismatches have proved to contribute to financial instability[10].

The importance of the global financial cycle in creating boom and bust cycles in emerging markets and advanced economies alike with capital inflows surges goes back a long way and has been mentioned in different contexts by Diaz Alejandro (1983), Calvo et al. (1996), (identification of "push factors" for capital flows), Eichengreen and Portes (1987), Reinhart and Reinhart (2008) (capital flows "bonanzas"), Lane and McQuade (2012) and many others. The role of cross-border flows in disrupting financial intermediation in the period leading to the 2008 crisis is stressed by Portes (2009) and Obstfeld and Rogoff (2010); Reinhart and Rogoff (2009) draw similar conclusions from the historical record.

Our VAR analysis suggests that one important determinant of the global financial cycle is monetary policy in the centre country, which affects leverage of global banks, credit flows and credit growth in the international financial system. This channel invalidates the "trilemma", which postulates that in

[10] See for example Kalemni-Ozcan et al. (2012).

a world of free capital mobility, independent monetary policies are feasible if and only if exchange rates are floating. Instead, while it is certainly true that countries with fixed exchange rates cannot have independent monetary policies in a world of free capital mobility, my analysis suggests that *cross-border flows and leverage of global institutions transmit monetary conditions globally, even under floating exchange-rate regimes*.

So should policy restrict capital mobility?

VI) Benefits of international capital flows

If restricting the movement of capital across border is to be a policy option, its potential benefit should be assessed against its costs. So what do we know about the gains to international capital mobility?

The literature has attempted to measure gains to free capital mobility mostly in two ways: by calibrating standard international macroeconomic models and evaluating welfare gains when going from autarky to financially integrated markets; by testing for growth effects and better risk sharing (lower volatility) following financial integration, using either panel data or event studies.

A) Calibration of standard models

The neoclassical growth model is behind many of our economic intuitions regarding why the free flow of capital could be beneficial. Within this model, financial integration brings improvements in allocative efficiency (capital flows to places with the highest marginal product) and better risk sharing. Interestingly, even within that paradigm, realistic calibrations indicate that gains tend to be small. Gourinchas and Jeanne (2006) show, in the context of small open economies and in a deterministic setting, that gains are second order. All that international financial integration does is to speed up transition toward the steady state of the economy. Coeurdacier et al. (2013) allow for uncertainty and estimate welfare gains from allocative efficiency and risk sharing together, in the context of a general equilibrium neoclassical growth model. The welfare gains are small, even in such a world where the interaction between the precautionary savings motives and allocative efficiency effects is modeled explicitly – so the two main channels of gains from integration can express themselves- . We find they are on the

order of a few tenths of a percent of permanent consumption for realistic calibrations.

B) Empirical evidence from panel data and event studies

Cross-border investment positions have risen for advanced economies from 68% of GDP in 1980 to 438% of GDP in 2007; for emerging markets they have gone from 35% to 73% of GDP during the same period (Lane and Milesi-Ferretti 2007 and Lane (2012)). If capital flows bring gains, we should be observing large effects in the data, due to the sheer scale of financial globalisation since the 1990s. There are numerous studies that try to test for effects of international capital flows on growth or on consumption volatility. Surprisingly, these effects are hard to find in macroeconomic data. As attested by the most recent surveys reviewing a long list of empirical papers, it is hard to find robust evidence of an impact of financial openness on growth or on improved risk sharing (see Eichengreen 2002; Jeanne et al. 2012; Kose et al. 2006; Obstfeld 2009). Some papers point toward the existence of threshold effects: capital flows are beneficial only after a country has reached a certain amount of institutional or financial sector development (see Bekaert *et al*. (2005)). There are also some differences if one looks across different types of capital flows: FDI flows seem better at delivering growth and risk sharing benefits than others. But this evidence is not very conclusive because the sample used often makes a difference (see Jeanne *et al*. (2012)). The literature based on event studies is often more positive (see Henry (2007)) and points towards a fall in the cost of capital and increased investment at the time of financial integration. But the simultaneity of other economic reforms or policies put in place at the time of financial opening is however often a concern. Further, from a theoretical point of view, evaluating welfare gains requires tracking the path of integrating economies from the point of capital account integration to their steady state. Along such paths, one can observe initial investment increases and current account deficits which then reverse later on as countries have to repay their external debt. Welfare gains along these paths are found to be small (see Coeurdacier *et al.* (2013)).

So both on the empirical side and on the calibration side, it is so far hard to find robust support for large quantifiable benefits of international financial integration. I do not claim that there are no benefits to international financial integration, only that they have been remarkably elusive so far given the scale of financial globalization the world has undergone. In that light, it would be useful to identify more precisely the channels for which capital flows may be beneficial. One possibility is to look more closely at potential effects on total factor productivity

of certain types of flows. The existing literature on this topic has to deal with hard identification issues and is also not very conclusive (for a discussion see Obstfeld 2009, p. 89). Another possibility is that financial FDI favours financial market deepening and thereby improves growth prospects[11]. Yet another possibility is to investigate more closely the risk sharing properties of the external balance sheet of countries during catastrophic events such as the 2007-2008 global financial crisis. Gourinchas *et al.* (2012) show that there were massive wealth transfers between the US and the rest of the world when the global financial crisis hit (about 2 trillion dollars valuation losses on the US net external asset position, which is equivalent to a wealth transfer to the rest of the world). The US, centre of the international monetary system, acted as a global insurer. It is easy to see how this insurance transfer is implemented: since emerging markets tend to be long in US government debt (the reserve asset) and short equity and FDI (and vice versa for the United States)[12], in times of crisis the value of a large part of their assets (US government bonds) is stable or even goes up while the value of their liabilities, consisting of risky assets, collapses. Thus, while large external balance sheets can help propagate financial crisis, they can also contribute to risk sharing depending on their exact structure. This is a further reason why monitoring gross flows and gross positions (as opposed to only net flows or current accounts) is essential.

To sum up, gains to international capital flows have proved elusive whether in calibrated models or in the data, though perhaps this is just because those gains are hard to measure. For example, they might occur through improvements in TFP, which we have not been able to measure precisely (but then why don't we see them in growth rates?) or they might manifest themselves mainly when large shocks hit. One thing is clear at this stage: we cannot take them for granted.

VII) Policy options: dealing with the "dilemma"

Gross capital inflows, leverage, credit growth and asset prices dance largely to the same tune. They co-move with the VIX. There is a global financial cycle, which may not be appropriate for individual countries. Symptoms can go from benign to large asset price bubbles and excess credit creation, a condition which has been identified repeatedly as one of the best predictors of financial crises. VAR

[11] For detailed work on operations of international financial institutions see in particular Cetorelli and Goldberg (2012).

[12] Gourinchas et al. (2010) show how to endogenize such asymmetric portfolios when the centre country of the international monetary system is more risk neutral than the rest of the world.

analyses suggest monetary conditions are transmitted from the main financial centre to the rest of the world through gross credit flows and leverage, irrespective of the exchange rate regime. This puts the traditional "trilemma" view of the open economy into question. Fluctuating exchange rates cannot insulate economies from the global financial cycle, when capital is mobile. The "trilemma[13]" morphs into a "dilemma" – independent monetary policies are possible if and only if the capital account is managed, directly or indirectly, regardless of the exchange-rate regime.

This implies that gross flows, particularly credit flows, are of great importance for financial stability and have to be monitored carefully. It is also only by looking at gross flows and gross cross border positions (the entire balance sheet of countries) that one can keep track of currency and maturity mismatch. Both of these mismatches have proved to contribute to financial instability, time and time again (see for example Farhi et al. (2012)). Once more, this is not to say net flows do not matter, as they are important for sustainability issues[14].

As welfare gains from capital flows cannot be taken for granted (though the jury is still out), we should consider the following range of options to weaken the potency of the global financial cycle and thereby increase financial stability. One could: a) impose targeted capital controls; b) act on one of the sources of the financial cycle itself: the monetary policy of the Fed and other main central banks; c) act on the transmission channel cyclically by limiting credit growth and leverage during the upturn of the cycle using national policies (and possibly doing the reverse during downturns) – *i.e.* putting in place macro-prudential policies; d) act on the transmission channel structurally by imposing stricter limits on leverage for all financial intermediaries.

a) Capital controls

One could consider capital controls either cyclical or permanent to insulate the economy from the global financial cycle. Permanent capital controls can be applied on subset of assets either on the inflow side or the outflow side. It is, at this stage hard to assess rigorously the effect of such policy on financial stability and its side effects, as, in the recent period, permanent controls have been implemented exclusively in a subset of low income countries, which have very specific characteristics (see Klein (2012)). Overcoming this selection issue is a major challenge.

[13] Alternatively the "impossible trinity" becomes an "irreconcilable duo".
[14] Gourinchas and Rey (2007) estimated that about a third of the adjustment of the United States towards its long run budget constraint came from valuation effects while the rest came from net exports (*i.e.* current account and net flows).

Temporary controls, especially on credit flows and portfolio debt when the cycle is in a boom phase could be used. This option has been tested in various contexts: the Chilean *encaje (*1991- 1998); the 2010 and 2011 Brazilian taxes on equity inflows etc… Often though, controls have been used with the primary aim of preventing excessive appreciation of the exchange rate. When capital flows in, an excessive exchange rate appreciation may hurt the export sector. As a result, Central Bankers may wish to intervene on the foreign exchange market to keep the currency down, accumulating reserves. They face the tradeoff of higher inflation or increased sterilization costs with a likely side effect of an increased interest rate leading to further inflows (also reinforced by expectations of further appreciation of the exchange rate). Taxing inflows, if effectively implemented can act as a circuit breaker in such a situation. There is a lively debate –as there are also difficult measurement issues linked to selection and endogeneity- on the effectiveness and side effects of temporary capital controls in this context (see for example Forbes et al. (2012), Chamon and Garcia (2013), Klein (2012), Werning (2012)).

Ultimately, since in our context, it is really excessive credit growth that is the main issue of concerns, capital controls should be viewed more as partial substitutes with macroprudential tools. The latter tend to be more targeted. But capital controls may be appropriate if there is a lot of direct cross-border lending and the banking system can be circumvented (see Ostry et al (2011)). It is important to note that macro-prudential policies can weaken the link between domestic monetary policy and capital inflows, without the imposition of capital controls. For instance, by preventing excessive credit growth in boom times, the Central Bank may reduce the incentive for banks to borrow externally when domestic monetary policy tightens.

b) Internalisation of the global spillovers of the centre's monetary policy

One could consider acting on one of the sources of the global cycle itself, the monetary policy stance in the main financial centres. Monetary conditions in large financial centres such as the US shape the global financial cycle via the endogenous response of leverage and the procyclicality of cross border credit flows. This transmission mechanism, unhindered by the flexibility of exchange rate transforms the "impossible trinity" of a fixed exchange rate, independent monetary policy and free capital mobility into the "irreconcilable duo" (a "dilemma") of independent monetary policy and free capital mobility. The spillover effects of large countries central bank's policies onto other countries are at present not internalized. Central bankers of systemically important countries should pay more attention to their collective policy stance and its implications for the rest of the world. One practical way of implementing this, proposed in Eichengreen et al. (2012) would be for "a small group of systemically significant central banks to meet regularly under the auspices of the Committee on the

Global Financial System of the BIS. This group would discuss and assess the implications of their policies for global liquidity, leverage, and exposures, and the appropriateness of their joint money and credit policies from the point of view of global price, output, and financial stability". It could issue a short report discussing policy tradeoffs and international inconsistencies. With time, this should at least help to understand better these complex issues –also by stimulating more research in these areas – and might encourage Central Bankers to internalize some of the external spillovers of the policies. The difficulties of such a policy option are obvious: international cooperation on monetary spillovers may conflict with the domestic mandates of central banks. For example, international financial stability and domestic activity and inflation targets may be at odds at least in the short to medium run. Furthermore the management of aggregate demand in systemically important economies also has important consequences for economic activity in the rest of the world. It is easy to see that the tradeoffs are extraordinarily complex.

c) Muting the transmission channel of the global cycle by taking cyclical measures (macro-prudential measures) to limit excessive credit growth.

Since, for a country, the most dangerous outcome of inappropriately loose global financial conditions is excessive credit growth, a sensible policy option is to monitor directly credit growth and leverage in each market. Recently, much effort has gone into putting in place macro-prudential measures having just this goal. The arsenal has several layers. Basel 3 has a countercyclical capital cushion that can be activated in boom times. Loan-to-value ratios and debt-to-income ratios can be used in order to restrict lending and keep real estate prices in check. One should also monitor closely lending standards and trading strategies during periods of high credit growth. There is a wealth of experience being gathered around the world recently on the practical implementation of macro prudential tools (see for example the Reserve Bank of India or the Bank of Korea where macroprudential measures were imposed including leverage caps on FX derivatives position and a macroprudential stability levy on non-core FX liabilities of banks (Bank of Korea Report 2013)). It is obvious that country-specific institutional details and market organization matter a lot. A centralized repository of the knowledge and experience gathered so far by supervisors and central bankers would be highly valuable.

Beyond the tools, one of the big practical issues is to determine the timing of intervention. When should one activate circuit breakers to cut the positive feedback loops described in Part IV?

It is important, not to wait too long; not to wait, for example, for the quasi-certainty that there is a bubble in asset prices or real estate to intervene.

One option is to devise automatic rules based on the credit to GDP ratio and act as soon as a certain threshold is crossed (Borio et al. (2011)). This has the advantage of being robust to lobbying of interested parties. It also overcomes the well known bias towards inaction when good times are unfolding and everyone is happily sharing the dividends of increasing asset returns, forgetting about the risk building up.

Another option is to stress-test the balance sheet of the financial sector (banks and shadow banks) very frequently, either in a targeted way or broadly, and judge whether large but realistic changes in asset prices could jeopardize financial stability. Stress testing is a difficult exercise in general and estimating second-round effects is particularly challenging. Furthermore, this is not a popular undertaking with market participants, as it requires regular inputs on top of mandatory reportings. It also requires careful thinking about communication policy (and/or absolute confidentiality as the case may be). Moreover, fiscal backstop strategies are needed to guarantee the credibility of the stress testing. None of this is easy. But doing stress tests regularly and often, even if this is an imperfect process, is a necessary monitoring tool. It improves the knowledge of supervisors and insures they are up to date with the recent market developments; importantly it may also give constructive challenges to the internal risk monitoring of institutions. It may reveal failures in corporate governance in organizations where incentives are not necessarily aligned to keep risk in check or where information is not available or centralized adequately. It may even reveal "blind spots" of risk taking activities occurring below the radar screen of the Chief Risk Officer. An aggressive policy of frequent stress tests, some targeted, some broad, can provide a flexible way to tackle the issue of excessive credit growth and leverage. Tests are particularly informative when they indicate whether if current financing conditions, including the shadow banking sector, were to be disrupted, financial stability could be endangered.[15]

d) Muting the transmission channel structurally by dampening the amplification capacity of financial intermediaries: tougher limits on leverage.

[15] We should not forget that, usually, there are a number of important domestic distortions that interact with capital flows and credit growth. In practice, for political reasons, we see many subsidies to investment in real estate and to debt. These subsidies are instrumental to creating the initial bubble or the beginning of a bubble in real estate prices and investment. By all means, the first thing to do is to remove these distortions. It is also important to remember that excessive borrowing by a country means that someone else is lending excessively: macroprudential policies apply to lenders just as well as they apply to borrowers.

At the heart of the transmission mechanism described in this paper is the ability of financial intermediaries, whether banks or shadow banks to leverage up quickly to very high levels when financing conditions are favourable. Credit is excessively sensitive to the financing costs. I start again, as in c) with the useful observation that the most dangerous outcome of inappropriately loose global financial conditions is excessive credit growth. It is possible in addition to or instead of monitoring the cyclical properties of credit growth to cut structurally the ability of financial intermediaries to be excessively procyclical. One policy lever seems particularly appropriate for doing this: the leverage ratio. By putting a tougher limit on leverage, the ability of the financial system to engage in the feedback loops discussed in sections V and VI will be curtailed. Complex macro prudential policies described above are not necessarily robust. Errors of judgements by supervisors, Chief Risk Officers, CEOs and boards are possible and even likely in our excessively complex financial and regulatory environment. Tougher leverage ratios may be in principle a way to decrease the (verifiably huge) cost of these errors, without imposing any large costs, if at all, on the real economy (see Haldane (2012), Jenkins (2012), Admati and Hellwig (2013))[16].

Conclusion

Of these four options, if history is of any guidance, putting in a place an effective international cooperation among the main central banks to internalise the spillovers of their monetary policies on the rest of the world seems out of reach[17]. And there are some reasons for that: international cooperation on monetary spillovers may conflict with the domestic mandates of central banks. For example, international financial stability and domestic activity and inflation targets may be at odds, at least in the short to medium run. Furthermore the management of aggregate demand in systemically important economies has important consequences for economic activity in the rest of the world. This is a major consideration. The rest of the world cannot at the same time complain of excessive capital inflows due to loose monetary policy in the centre countries and wish for a higher level of economic activity and demand stimulus in the same countries. Tradeoffs are extraordinarily

[16] Of course excessive complexity in regulation has also the downside of letting a well resourced industry find loopholes or create them as well as encouraging risky bets guided by regulatory arbitrage. Complexity often goes with lack of transparency and heterogeneous implementation.

[17] Policy coordination was a major theme in international macroeconomics in the 1980s (see, *e.g.* Buiter and Marston (1985) and Bryant and Portes (1987)). The G7 summits of 1986 (Tokyo) and 1987 (Venice) emphasized multilateral surveillance. To this day, however neither the economic analysis nor the policy pronouncements have had any observable effect on actual monetary policies.

complex and policy action will most likely remain biased towards national priorities. A transparent forum in which the collective monetary policy stance of the systemically important central banks is actively discussed and inconsistencies analysed would reduce the risk of volatility in capital flows[18].

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Appendix A

List of countries included:

North America	*Latin America*	*Central & Eastern Europe*	*Western Europe*	*Emerging Asia*	*Asia*	*Africa*
Canada	Argentina	Belarus	Austria	China	Australia	South Africa
US	Bolivia	Bulgaria	Belgium	Indonesia	Japan	
	Brazil	Croatia	Cyprus	Malaysia	Korea	
	Chile	Czech Republic	Denmark	Thailand	New Zealand	
	Colombia	Hungary	Finland			
	Costa Rica	Latvia	France			
	Ecuador	Lithuania	Germany			
	Mexico	Poland	Greece			
		Romania	Iceland			
		Russian Federation	Ireland			
		Serbia	Italy			
		Slovak Republic	Luxembourg			
		Slovenia	Malta			
		Turkey	Netherlands			
			Norway			
			Portugal			
			Spain			
			Sweden			
			Switzerland			
			UK			

Data on Capital flows:

Source of flow data: quarterly gross capital inflows and outflows from the International Monetary Fund's International Financial Statistics (accessed through IMF website in March 2013) for:

Portfolio Equity Inflows, Outflows and Net Flows constructed as Outflows-Inflows (Assets-Liabilities)

FDI Inflows, Outflows and Net Flows

Portfolio Debt Inflows, Outflows and Net Flows, and

Other Investment Inflows, Outflows and Net Flows

Data transformations: Flows are reported in millions of U.S. dollars

IFS does not differentiate between true zeros and not availables; most of the times we treat these values as errors and omissions, unless they evidently represent zero flows.

Mapping of the flows from BPM5 (until 2004 Q4) to BP6 (2005 Q1 onwards) in accordance to the guidelines of the 6th edition of the Balance of Payments and International Investment Position Manual of IMF – Reconciliation for quarters 2005 Q1-2008 Q4 for which there is data overlap.

Construction of Net Flows only when data on Inflows and Outflows are available

World GDP Growth (Quarterly): International Monetary Fund's International Financial Statistics (accessed through IMF website in March 2013).

Appendix B

Global Factor: common factor extracted from a collection of 858 asset price series spread over Asia Pacific, Australia, Europe, Latin America, North America, Commodity and Corporate samples. For details on extraction and original asset prices dataset composition please refer to Miranda Agrippino and Rey (2012).

Banking Sector Leverage: constructed as the ratio between Claims on Private Sector and Transferable plus Other Deposits included in Broad Money of Depository Corporations excluding Central Banks. Data are in national currencies from the Other Depository Corporations Survey; Monetary Statistics, International Financial Statistics database. Classification of deposits within the former Deposit Money Banks Survey corresponds to Demand, Time, Savings and Foreign Currency Deposits.

EU Banking Sector Leverage: constructed as the median Banking Sector Leverage of the initial 12 Euro Area Countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal and Spain) and the UK.

US Brokers-Dealers Financial Leverage: constructed as the ratio of Security Broker and Dealers Financial Assets and Total Liabilities; Federal Reserve Board; Financial Accounts, release Z.1

Domestic Credit: constructed as the sum of domestic claims of Depository Corporations excluding Central Banks. Domestic claims are defined as Claims on Private Sector, Public Non-Financial Corporations, Other Financial Corporations and Net Claims on Central or General Government (Claims less Deposits); Other Depository Corporation Survey and Deposit Money Banks Survey; Monetary Statistics; IFS. Original data in national currencies.

Direct Cross-Border Credit: measured as difference in claims on all sectors or non-bank sector of a given country of all BIS reporting countries in all currencies; Locational Statistics Database; International Bank Positions by Residence; BIS; Tables 7A and 7B.

Global Inflows: constructed as the sum of direct cross-border credit to non-bank sector in the 53 countries sampled for the panel data analysis; list of countries sampled at the end of this section.

Nominal GDP Data in USD: original data in national currencies from National Statistical Offices; Haver Analytics conversion using spot end of period FX rates.

VIX: end of period readings; Chicago Board Option Exchange (CBOE).

Stock Market Indices: end of period close quotes; Haver Analytics and Global Financial Data.

House Price Indices: OECD, BIS.

Exchange Rates: in national currency per US Dollar; end of period; International Financial Statistics.

Nominal Effective Exchange Rate: Broad Effective Exchange Rate Indices, BIS

US GDP: Real Gross Domestic Product (Billions of Chained 2005 Dollars); Bureau of Economic Analysis

US INFLATION: Gross Domestic Product: Implicit Price Deflator (Index 2005=100); Bureau of Economic Analysis

FFR US: Effective Federal Fund Rates, End of Period (% p. a.); Federal Reserve Board; Selected Interest Rates, release H.15

Countries in the panel: Argentina, Australia, Austria, Belarus, Belgium, Bolivia, Brazil, Bulgaria, Canada, Chile, Colombia, Costa Rica, Croatia, Cyprus, Czech Republic, Denmark, Ecuador, Finland, France, Germany, Greece, Hong Kong , Hungary, Iceland, Indonesia, Ireland, Italy, Japan, Korea, Latvia, Lithuania, Luxembourg, Malaysia, Malta, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Serbia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, United States.

Appendix C

Table 2

Table 2 (b) Banking Sector Leverage Growth $lv_{i,t}$, is the dependant variable (1990-2013)							
fl_{it}	Credit L	C.nonbank L	Credit A	Debt L	Debt A	Equity L	Equity A
VIX_t	-0.0125*** (-3.84)	-0.0122*** (-3.82)	-0.0127*** (-3.87)	-0.0121*** (-4.02)	-0.0127*** (-3.87)	-0.0140*** (-3.70)	-0.0121*** (-3.43)
ΔVIXt	0.0164*** (4.06)	0.0167*** (-4.4)	0.0171*** (4.44)	0.0167*** (4.26)	0.0174*** (4.39)	0.0175*** (4.49)	0.0190*** (4.81)
$fl_{it}*VIX_t$	0.00 (1.28)	0.0014 (-1.39)	0 (0.67)	0.0007 (1.09)	0 (0.89)	0 (-0.36)	0.0005 (1.24)
$fl_{it-1}*VIX_{t-1}$	-0.0002 (-0.61)	0.0014 (-1.43)	0 (-0.56)	0.0001 (0.34)	0.0001 (0.67)	0 (0.29)	-0.0003 (-1.18)
Adj. R2	0.01	0.008	0.008	0.009	0.008	0.007	0.011
N	2352	2405	2370	2273	2332	2018	2167

Fixed effect estimator, standard errors adjusted for clustering on country, t-stat in parentheses. All specifications include the control variables and a linear trend.

Table 2 (c) House price inflation $h_{i,t}$ is the dependant variable (1990-2013)							
fl_{it}	Credit L	C.nonbank L	Credit A	Debt L	Debt A	Equity L	Equity A
VIX_t	-0.0174*** (-3.66)	-0.0127*** (-3.68)	-0.0170*** (-3.52)	-0.0183*** (-3.52)	-0.0179*** (-3.74)	-0.0166*** (-3.60)	-0.0178*** (-3.36)
ΔVIXt	0.0073*** (2.91)	0.0051** (-2.03)	0.0072*** (2.88)	0.0076*** (2.87)	0.0082*** (3.5)	0.0081*** (4.33)	0.0074*** (2.89)
$fl_{it}*VIX_t$	0.00 (1.04)	0.001 (-0.99)	0.0001 (1.07)	0.0003 (1.16)	0 (0.3)	0 (0.59)	0.0001 (0.65)
$fl_{it-1}*VIX_{t-1}$	0.0001 (1.00)	0.0018 (-1.11)	0 (-0.09)	0.0001 (0.56)	0 (0.08)	0 (-0.02)	0.0001 (0.59)
Adj. R2	0.07	0.064	0.068	0.066	0.063	0.058	0.076
N	2335	2490	2358	2263	2303	2044	2166

Fixed effect estimator, standard errors adjusted for clustering on country, t-stat in parentheses. All specifications include the control variables and a linear trend.

Appendix D:

Figures 1a,b,c: heatmaps of correlations of gross inflows, gross outflows and net flows

Figure 2: plots capital inflows disaggregated by asset types (FDI, portfolio equity, portfolio debt and credit) as a proportion of the world GDP for the period 1990Q1-2012Q4 and it reports the VIX (inverted scale) on the same graph.

Figure 5: Complete set of Impulse response functions of the VAR.