

Evaluating capital flow management measures used as macro-prudential tools

by

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Earlier OECD research has shown that capital flow management measures (CFMs) that are used as macro-prudential measures (MPMs), including currency-based restrictions applied to banks' operations also with non-residents, have the intended negative impact on capital account openness as measured by covered interest parity indicators. But what is their impact as macro-prudential tools to improve resilience to financial stability risks?

This paper refers to the Bruno and Shin (2013) study that suggests that currency-based restrictions act as an effective macro-prudential buffer by reducing the sensitivity in emerging economies of cross-border bank lending to global credit cycles as measured by the volatility index VIX. The specific restrictions considered by the Bruno and Shin study are defined as CFMs and MPMs by both the IMF and the OECD. The paper shows that this result is mitigated when using updated data and testing the same hypotheses for more countries. Therefore further research is needed before concluding on the effectiveness of CFMs used as MPMs. On the other hand, the paper does find that CFMs, including currency-based measures, play a role in managing the domestic credit implications of those central banks engaged in foreign exchange interventions.

The paper suggests that countries concerned with financial stability risks that may arise from global credit push factors, while wishing to avoid price distortions caused by CFMs, could use Basel III-consistent liquidity coverage ratios and net stable funding ratios as alternatives to CFMs; they also have the advantage of not having raised objections between governments so far regarding international commitments to exchange rate flexibility and cross-border openness, including the OECD Code of Liberalisation of Capital Movements.

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I. Introduction

Macro-prudential measures (MPMs) attempt to deal with potential systemic banking problems that may arise from the macro credit cycle and which are not easily treatable with micro-prudential capital regulations. Some of these policies may use Basel framework tools in a counter-cyclical manner by implementing countercyclical capital buffers and using liquidity coverage ratios (LCRs) and net stable funding ratios (NSFRs). Such tools have the advantage of falling into the category of being internationally agreed mechanisms that do not conflict with other obligations countries may have. The right balance needs to be found, as an open multilateral regime for international capital flows serves the global economy well, allocating cross-border saving and investment efficiently, thereby improving productivity and supporting sustainable economic growth. The BIS Annual Report for 2010 alludes to the idea that these potential conflicts should be minimised: “macro-prudential measures cannot substitute for tightening monetary policy and increasing exchange rate flexibility as a means to promote orderly and sustained domestic and external adjustments”.¹

It is widely recognised that CFMs can be important at times in dealing with temporary country-specific crises. The IMF has set out their own guidance to staff on the circumstances when this might be appropriate.² This is entirely compatible with the OECD Code of Liberalisation of Capital Movements,³ provided transparency and scrutiny of measures is maintained at the international level. Since less transparent and more permanent approaches to restrictions can lead to negative collective outcomes, the OECD Code of Liberalisation of Capital Movements is a binding international agreement that provides for progressive liberalisation while recognising that countries may need to introduce new capital flow restrictions in certain circumstances.⁴ Consistency with the IMF’s guidance is set out in the OECD Report to the G20 and the *Update by the IMF and OECD on Cooperation on Approaches to Macro-prudential and Capital Flow Management Measures*.⁵

While the usefulness of the temporary CFMs in a crisis situation is undisputed, the efficacy of maintaining CFMs over the longer term for managing systemic financial risks needs to be evaluated against their costs.⁶ An OECD study⁷ using company data has shown that in countries which maintain long-term cross-border controls there is a clear negative effect on company capital expenditure,⁸ after controlling for other factors, resulting from persistent deviations from covered interest parity.⁹ There is therefore a need to evaluate whether there are approaches to macro-prudential concerns that are consistent with internationally agreed tools which are not designed to limit capital flows, allowing countries better to meet their commitments under the OECD Code of Liberalisation of Capital Movements. This paper examines the efficacy of CFMs intended as MPMs, and explores whether Basel-related tools may help to resolve some of these issues of conflicting objectives.

II. The Bruno and Shin framework

The often cited study by Bruno and Shin (2013) provides an interesting approach for examining the efficacy of CFMs as MPMs to avoid banking crises that may arise from interactions with the rest of the world. Bruno and Shin (2013) focus on one country as part of a large panel of countries to see whether two measures that are both CFMs and MPMs introduced by that country around June 2010 have reduced these interactions, using this to draw more generic conclusions on the effectiveness of CFMs as MPMs. This paper uses their very useful framework to examine these issues for a larger group of countries.

Bruno and Shin (2013) state:

*“Our purpose in this paper is to give a preliminary empirical assessment of the impact of the measures introduced [...] and to revisit the rationale behind their design, in order to refine the thinking behind capital flows and financial stability.”*¹⁰

There is an international dimension to the credit cycle (booms and busts) that may have systemic consequences. This is because banks resort to global funding from wholesale markets which may be rapidly withdrawn in the bust cycle. Global banks expand leverage in “risk-on” periods characterised by a low level of the VIX¹¹ and remove it when the VIX spikes upwards. Global leverage is inversely related to the VIX, which the authors refer to as a “supply push” factor. A low VIX is associated with high leverage so that a given unit of the bank’s capital translates into a higher level of cross-border claims and vice versa.

As a part of this process US subsidiaries of foreign banks can be lending outposts or, alternatively, sources of net dollar funding (essentially borrowing dollars and channelling it to their headquarters). This can be measured by the net interoffice position of foreign banks in the US; i.e. the net dollar claim of the parent on subsidiaries consolidated across all banks. From 2001 to mid-2011 this switched from being previously negative (net lending by subsidiaries) to positive (net funding by subsidiaries). Problems for exposed countries arose with the sudden withdrawal of this source of funding at the height of the European banking crisis in 2011 (when the series moves back into deeply negative territory).

The dependent variable the authors seek to explain is cross-border capital flows within the banking system of BIS reporting banks. Supply is the lending by global banks and demand is the borrowing by local banks. The very specific measures in the case investigated by Bruno and Shin include:

- A leverage cap on net foreign derivatives (June 2010), which reduces bank returns and acts as a quantitative limit to expanding derivatives.
- A 20bp levy on non-core forex liabilities of banks up to 12 month maturity; and lower rates in a graduated manner for maturities over 1 year (paid into a special segregated account of the forex reserves).

The policy view being tested is that global supply “push factors” can be offset by such measures. The presumption is that these global dynamics are pro-cyclical, that pro-cyclicality leads to liquidity and solvency risks for banks, and that these can be offset by CFMs. Any banking system prudential stability benefits here are presumably assumed to outweigh any cost-of-capital distortions for domestic firms caused by any persistence of deviations from covered interest parity and the possible reduced long-term breadth and depth of financial markets.

Empirical approach

The purpose of this paper is to explore alternative hypotheses to those postulated by Bruno and Shin (2013), a well-recognised and academically refereed article.¹² The strategy is to apply the Bruno and Shin approach using updated data to a larger number of countries in the panel to see how general the findings might be (as opposed to being specific to one country's two measures). The present authors validated the original study for the country investigated by Bruno and Shin and believe it to be a useful approach for examining the thinking behind capital flows and financial stability. Thus if CFM policies are not found more generally to be an efficient approach to reducing the pro-cyclicality of the global credit cycle for banks, then: (i) other costs associated with such measures might have a higher weighting in policy choices, and (ii) alternative approaches to prudential concerns might have more advantages.

The Bruno and Shin empirical investigation is based on various modifications of the following benchmark model:¹³

$$\Delta \text{BANK}_{c,t} = \alpha_{c,t} + \beta_1 \Delta \text{INTER}_{t-1} + \gamma_1 \text{VIX}_{t-1} + \delta_1 \Delta \text{VIX}_t + \text{CONTROL VARIABLES} + \varepsilon_{c,t},$$

where subscripts "c" and "t" refer to countries and quarters, respectively.

The dependent variable is the quarterly log difference in external claims (loans and deposit) of BIS reporting banks vis-a-vis the borrowing country under consideration (ΔBANK).¹⁴ Explanatory variables are:

- The growth in net interoffice liabilities of foreign banks in the United States (ΔINTER), where a quarterly percentage change is used.¹⁵
- The log level of the VIX as a proxy of the risk aversion of investors which is inversely related with the level of leverage, and the quarterly log difference of the VIX (ΔVIX) for the change in leverage.
- Control variables: the quarterly difference in the log of the real exchange rate (ΔRER , expressed as local currency/USD, deflated by CPIs);¹⁶ the quarterly log difference of the global money supply (ΔM);¹⁷ the year-on-year GDP growth rate with a quarterly frequency (ΔGDP); and a country's year-on-year percent change in government gross debt-to-GDP with a quarterly frequency (ΔGovt).¹⁸

All quarterly variables (with the exception of ΔVIX) are lagged by one quarter to mitigate endogeneity issues. Regressions include country fixed effects, year dummies and clustered standard errors at the country level.

The Bruno and Shin empirical approach is to include in the benchmark model interaction terms with the following two dummy variables:

- a dummy variable for the country to be considered separate from the panel: D_{COUNTRY} ;
- a dummy variable for the post-2010 period (i.e. equal to 1 since 2010 Q2): D_{2010} .¹⁹

Country coefficients are estimated separately in the full panel for ΔINTER , VIX and ΔVIX post 2010, to see whether the focus country is different from the sample, and to explore how sensitivity to net interoffice liabilities ("interoffice") and the VIX behaved post 2010.

Accepting a hypothesis that the focus country's measures introduced in 2010 are responsible for observed parameter changes on the basis of a dummy variable methodology may be legitimate. However, a lot of other factors were coming into play

around the period 2008-12. Bank risk management processes have changed since 2008 as a result of banking regulatory reforms and a general increase in risk aversion may have taken place after the global crisis. On the other hand, their country of focus has not been alone in imposing new cross-border measures since the crisis.²⁰ It will be interesting from the viewpoint of the debate on macro-prudential policy to test more countries in the same manner of the country investigated by Bruno and Shin and to focus on emerging countries which generally have been using CFMs and advanced countries that generally have not.

The two augmented models are:

$$\Delta \text{BANK}_{c,t} = \alpha_{c,t} + \beta_1 \Delta \text{INTER}_{t-1} + \beta_2 \Delta \text{INTER}_{t-1} * D_{2010} + \beta_3 \Delta \text{INTER}_{t-1} * D_{\text{COUNTRY}} + \beta_4 \Delta \text{INTER}_{t-1} * D_{2010} * D_{\text{COUNTRY}} + \gamma_1 \text{VIX}_{t-1} + \delta_1 \Delta \text{VIX}_t + \zeta_1 D_{2010} * D_{\text{COUNTRY}} + \text{CONTROL VARIABLES} + \varepsilon_{c,t}$$

$$\Delta \text{BANK}_{c,t} = \alpha_{c,t} + \beta_1 \Delta \text{INTER}_{t-1} + \gamma_1 \text{VIX}_{t-1} + \gamma_2 \text{VIX}_{t-1} * D_{2010} + \gamma_3 \text{VIX}_{t-1} * D_{\text{COUNTRY}} + \gamma_4 \text{VIX}_{t-1} * D_{\text{COUNTRY}} * D_{2010} + \delta_1 \Delta \text{VIX}_t + \delta_2 \Delta \text{VIX}_t * D_{2010} + \delta_3 \Delta \text{VIX}_t * D_{\text{COUNTRY}} + \delta_4 \Delta \text{VIX}_t * D_{\text{COUNTRY}} * D_{2010} + \zeta_1 D_{2010} * D_{\text{COUNTRY}} + \text{CONTROL VARIABLES} + \varepsilon_{c,t}$$

The tests of the null hypotheses focused on are that:

- $\beta_2 + \beta_4 = 0$; i.e. that there has been no change in the sensitivity of external loan growth of the country of focus with respect to interoffice before and after 2010.
- $\beta_3 + \beta_4 = 0$; i.e. that there is no difference in the sensitivity of external loan growth between the focus country and the rest of the sample with respect to interoffice after 2010.
- $\beta_1 + \beta_2 + \beta_3 + \beta_4 = 0$; i.e. that the total effects of interoffice have no effect on the loan growth of the focus country after 2010.

Analogous hypotheses apply for the VIX and ΔVIX coefficients γ and δ .

The Bruno and Shin results

Exploiting the panel data Bruno and Shin (including 48 countries²¹ over the period 1996 Q1 to 2012 Q1), the results presented in Table A1.1 show:

- $\beta_2 + \beta_4 = 0$ is rejected by the data and the sum is negative and significant, supporting the hypothesis that the sensitivity of external loan growth with respect to interoffice is weaker for the country of focus than for the other countries in the sample.
- $\beta_3 + \beta_4 = 0$ is rejected by the data and the sum is negative and significant, supporting the hypothesis that interoffice sensitivity for the focus country is weaker than for countries in the rest of the sample post-2010.
- $\beta_1 + \beta_2 + \beta_3 + \beta_4 = 0$ cannot be rejected, supporting the hypothesis that there is no total effect of interoffice on external bank loans after 2010.
- $\gamma_2 + \gamma_4 = 0$ is rejected by the data and the sum is negative and significant, supporting the hypothesis that the sensitivity of external loan growth with respect to VIX is stronger for the focus country than for the other countries in the sample (the VIX and leverage are inversely related).
- $\gamma_3 + \gamma_4 = 0$ is rejected by the data and the sum is negative and significant, supporting the hypothesis that the sensitivity of external loan growth with respect to VIX is stronger for the focus country than for the other countries in the sample post-2010.
- $\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4 = 0$ is rejected, supporting the hypothesis that there is a total stronger, positive effect of the VIX on external bank loans after 2010.

- $\delta_2 + \delta_4 = 0$ is rejected by the data and the sum is positive and significant, supporting the hypothesis that the sensitivity of external loan growth with respect to ΔVIX is weaker for the country of focus than for others in the sample.
- $\delta_3 + \delta_4 = 0$ is accepted by the data, supporting the hypothesis that there is no difference for the focus country than for the rest of the sample post-2010.
- $\delta_1 + \delta_2 + \delta_3 + \delta_4 = 0$ cannot be rejected, supporting the hypothesis that there is no total effect of ΔVIX after 2010.

III. Implications for the effectiveness of CFMs as macro-prudential tools

Annex A1 explains that the Bruno and Shin results have been verified using the original data used by the authors, though the same framework gives rise to some interesting differences when testing the same hypotheses with updated data and for more countries.²²

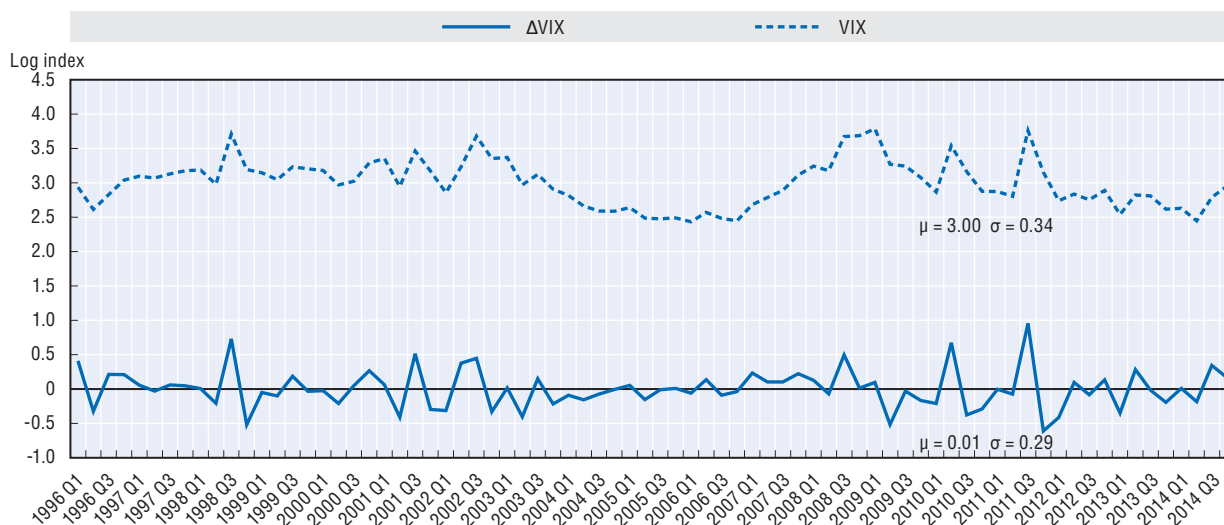
These updated findings (shown in Annex A1 Tables A1.2 and A1.3) are as follows:

- The Bruno and Shin result for the sensitivity of interoffice post-2010 is confirmed for 18 of the 20 countries selected, and applies equally across countries whether they have cross-border capital controls or not. It seems that the finding may not be due to specific measures but to more general global phenomena. This may have more to do with general banking reforms and more stringent capital rules as well as changes to banks' own risk management considerations than to any one country's application of measures in and around 2010. With respect to sensitivity versus the full panel, four of ten advanced countries are more counter-cyclical versus only two of the CFM group (with $\gamma_2 + \gamma_4 > 0$).²³
- By far the most important variable to focus upon in this exercise is the level of the VIX, shown in Figure 1, for two reasons. First, interoffice is in any case a poorly constructed variable (negative numbers and crossing zero distort the variable) and any comments on it must be taken with a grain of salt. Second, ΔVIX is more akin to an auto-correlation correction term that changes sign over very short horizons and has a smaller quantitative effect.²⁴ Four large advanced countries without recourse to cross-border controls, both before and after 2010 are, on balance, more resilient in relation to the level of the VIX, suggesting that the depth of markets and liquidity may be relevant factors in cross-border sensitivity to the global credit cycle. In contrast, six of the ten advanced and six of the CFM countries have negative coefficients, implying more sensitivity to the level of the VIX (pro-cyclical) post-2010. Five advanced and seven CFM countries appear to be more vulnerable than countries in the full panel after 2010. All ten CFM countries and seven in the advanced group show a total effect deterioration post-2010.
- Even with respect to the ΔVIX variable the results are mixed between advanced and emerging countries. Only one country in the CFM group exhibits a lower total sensitivity after 2010, with eight others showing an increase. In the advanced country group Germany, Japan and Switzerland show a clear improvement in their resilience to increases in the volatility measure.

IV. Alternative reasons for using CFMs with a macro-prudential intent

The above results with updated data and a longer sample period suggest that CFMs do not appear to be an efficient macro-prudential tool for dealing with the global credit cycle “push factors” studied by Bruno and Shin (2013). The results with respect to the interoffice

Figure 1. The natural logarithm and different in log of the VIX Index



Source: Bloomberg.

variable appear to be a global phenomenon, and emerging countries have overall “deteriorated” in relation to the VIX factor. This raises the question as to whether there might be additional reasons for countries to use CFMs with a macro-prudential intent. One possibility is that countries are concerned with the macro-prudential problems that might arise with foreign exchange intervention to reduce volatility in the exchange rate and/or other contributions to changes in reserves. Changes in international reserves directly affect domestic credit and raises macro-prudential concerns through this channel:

- In the face of inflows, attempts to lessen the upward pressure on the exchange rate imply buying dollars and selling the domestic currency, which expands credit and may result in domestic asset price inflation (as opposed to the global push factors in the Bruno-Shin framework). CFMs would lessen this risk, since smaller inflows would constitute less pressure on the exchange rate and for foreign exchange intervention.
- Equally concerning from a macro-prudential point of view would be the consequences of outflows and resisting a sharply falling exchange rate. Intervention would contract domestic bank balance sheets. This would also risk speculative pressure as reserves are run down – a “break the peg” mentality on the part of speculators might emerge. Fear factors of sudden losses could also be a factor accelerating outflows of funding. Once again CFMs would lessen this risk and the amount of foreign intervention felt necessary.

These hypotheses are reasonably easy to test. If central banks do not respond to the global credit cycle in their foreign exchange transactions, then applying the Bruno-Shin tests with the log difference of international reserves as the dependent variable instead of cross-border bank lending should see the null hypothesis of no sensitivity accepted by the data.

The panel is divided into two separate groups: first, advanced economies that have open banking systems; and second, emerging markets²⁵ that may use CFMs and where foreign exchange intervention is generally more prevalent. The post-2010 dummy variable is used and tests are run by including interaction terms alternately, first for Δ INTER and then for VIX and Δ VIX. The results are shown in Table 1.

Table 1. **Panel Regressions on International Reserves over the period 1996 Q1 to 2014 Q4**

	Advanced Economies	Emerging Economies
β_1	-0.0704**	0.0101
β_2	0.0825	-0.0291*
γ_1	-0.0664	-0.0939***
γ_2	0.0191**	0.0168***
δ_1	-0.00211	-0.0400**
δ_2	-0.0555**	-0.0205
F-Tests of Null Hypotheses		
$\beta_1 + \beta_2 = 0$	0.0125	-0.019 *
$\gamma_1 + \gamma_2 = 0$	-0.0473	-0.0771 ***
$\delta_1 + \delta_2 = 0$	-0.0576 **	-0.0605 ***

Note: This table presents panel regressions of 49 countries applying the Bruno and Shin framework, but where the dependent variable is the quarterly log difference of international reserves ($\Delta RESV$) instead of interbank loans. See text for explanation of methodology and variables' description. Data are from 1996 Q1 to 2014 Q4. Standard errors are not shown and significance is indicated by asterisks: *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. F tests of the null hypotheses are shown in the bottom panel for the sum of coefficients.

Source: OECD calculations.

The parameters refer to the same variables set out earlier.

- For the advanced countries the F-tests of $\beta_1 + \beta_2 = 0$, and $\gamma_1 + \gamma_2 = 0$ are accepted by the data, and that for $\delta_1 + \delta_2 = 0$ is rejected at the 5% level. The latter is consistent with some short-run volatility impacts on international reserves (ΔVIX), but there are no sustained impacts associated with the level of the VIX or interoffice.
- A very different and clear result emerges for the panel that uses CFMs. The negative β coefficient post-2010 appears to be consistent with central banks “filling the gap” in response to fluctuations in interoffice funding. The γ_1 coefficient is negative and significant at the 1% level – a fall in the VIX is associated with rising international reserves as central banks resist the impact of global credit cycle inflows on the exchange rate, and vice versa. However the γ_2 coefficient is positive (less responsive) and also significant at the 1% level. That is, to the extent that cross-border restrictions increased after 2010, reserves have been less responsive – the sum of the coefficients ($\beta_1 + \beta_2$) post-2010 is still negative, but less so than it was prior to 2010.

V. Internationally agreed instruments for macro-prudential purposes avoiding CFMs

Cross-border capital flow measures distort relative prices and limit company access to lowest cost of financing solutions for capital expenditure projects. There is also an element of circular reasoning: CFMs work against building the depth and efficiency of a country's financial markets which reduce dislocations caused by illiquidity and price volatility. An alternative solution would be to work within the Basel framework as it might be used to deal with currency-related macro-prudential concerns. This is for two main reasons. First, the Basel framework has so far not raised any objections by governments regarding international commitments to exchange rate flexibility and cross-border openness, including the OECD Code of Liberalisation of Capital Movements.²⁶ Second, it would deal with the macro-prudential concern while allowing relative prices (interest rates and exchange rates) to adjust in a non-distorted fashion, improving the allocation of resources.

Annex A2 illustrates a possible approach to the prudential issues for banks caused by cross-border flows using a very simplified bank balance sheet to illustrate how the Basel Liquidity Coverage Ratio (LCR) and possibly the Net Stable Funding Ratio (NSFR) might be used in this context.

VI. Conclusions

In this paper, the Bruno and Shin framework was first validated using their own data. The data were updated and the framework applied to a selection of advanced and emerging economies (the latter using CFMs of some form). The revisions to interoffice data (net interoffice liabilities of foreign banks in the United States) significantly affected the results, bringing into question whether CFMs have really helped to reduce dollar funding risks from US subsidiaries. The main findings were that virtually all countries experienced less sensitivity of external loan growth with respect to the interoffice variable after 2010, whether or not they used CFMs. The explanation of this finding is more likely to be found in global regulatory reform and risk practices within banks themselves rather than specific country CFMs.

The results in relation to the global credit cycle (captured by the level of the volatility index VIX) were different between the advanced and the emerging economies selected. For a few countries in the advanced economy group which are both large and have well-developed financial systems the data suggest that they became less sensitive to the VIX after 2010. This may be due to the liquidity of their financial systems and/or to the scale of the impact of new financial regulations negotiated within the Basel framework. At the same time, in this group, some smaller advanced economies that have not been using CFMs appear to have become more sensitive to the global credit cycle post-2010.

One of the clearest results of this study is that post-2010 all ten of the CFM countries studied experienced a rise in total sensitivity to the global credit cycle as measured by the level of the VIX –findings which are statistically significant at the 1% level. Since 2010 a number of emerging economies have implemented more CFMs. Therefore, to the extent that CFMs have a macro-prudential intent, the panel results suggest that they are not an efficient policy approach for achieving this end.

When international reserves were used as the dependent variable instead of external loans, using the Bruno and Shin framework, with the panel divided into advanced and emerging economies, quite different results were found for responsiveness to the global credit cycle. In the advanced economies panel, the null hypotheses of “no international reserves sensitivity to the VIX before and after 2010”, is supported by the data. For the emerging economy group, reserves are responsive to the level of the VIX with a negative sign (significant at the 1% level) before 2010. The post-2010 dummy has a positive sign, suggesting reduced sensitivity over the period when CFMs apparently increased. The total effect remains negative post-2010, but less negative than it was in the earlier period. By reducing the amount of foreign exchange intervention felt needed to resist exchange rate volatility, CFMs appear to attenuate the macro-prudential risks that result from such intervention policies via the domestic credit cycle.

If CFMs are not the most effective way to address macro-prudential concerns resulting from foreign funding of domestic lending, then perhaps more consideration could be given to using Basel-consistent tools towards this end, particularly if they are found to be more

consistent with international commitments, including the OECD Code of Liberalisation of Capital Movements.

Notes

1. See Bank for International Settlements (2010).
2. See IMF (2012, 2014a,b).
3. The OECD Code of Liberalisation of Capital Movements and Current Invisible Operations; see <http://www.oecd.org/daf/inv/investment-policy/codes.htm>.
4. New restrictions can be introduced following due process in the collective interest of transparency and accountability, by lodging reservations or invoking derogations within the framework of the OECD Code of Liberalisation of Capital Movements. Reintroducing capital flow restrictions can play a role in specific circumstances. In these circumstances, transparency and international co-operation are important.
5. See OECD (2015a,c).
6. See OECD (2015 c).
7. See Blundell-Wignall and Roulet (2014).
8. This is related to the higher cost of capital resulting from restrictions on capital movements.
9. Other studies also point in this direction. See Harrison, Love and McMillan (2004); Chari and Henry (2004); Forbes (2003, 2007); Desai, Foley and Hines (2004).
10. See Bruno and Shin (2013).
11. VIX is a trademarked ticker symbol for the Chicago Board Options Exchange Chicago (CBOE) Volatility Index, a popular measure of the implied volatility of S&P 500 index options. Often referred to as the “fear index” or “the fear gauge”, the VIX represents one measure of the market's expectation of stock market volatility over the next 30-day period.
12. The model and its control variables form a benchmark to which alternative interpretations might be explored when applied to more countries. The aim in no case is to build an alternative Bruno and Shin model with different control variable. Instead the aim is to use it as a well-known reference point for testing and interpreting a broader set of data and hypotheses.
13. See Bruno and Shin (2011).
14. Taken from Table 7A of the BIS statistical publication.
15. See Board of Governors of the Federal Reserve System, Data Release, Series H8 on commercial banks.
16. Taken from the IMF's IFS database.
17. It is calculated as the quarterly log difference of the sum of the M2 stock in the US, Eurozone and Japan and M4 in the UK (data from the IFS).
18. Data for the last two variables are taken from the IMF's WEO database.
19. In this paper, this dummy variable does not necessarily reflect changes in the intensity of CFM measures for all countries. The main purpose is to discuss the robustness of Bruno and Shin's (2013) results and extend their analysis by postulating alternative hypotheses and investigate the behaviour of several different groups of countries. For example, while their country of focus imposed measures in 2010, a type 2 error might be suggested if other countries that did nothing in 2010 also have the same result as found for the focus country – something else might explain their result.
20. See OECD (2015b), Chapter 3.
21. Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Cyprus, Czech Republic, Denmark, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Korea, Latvia, Lithuania, Malaysia, Malta, Mexico, Netherlands, Norway, Philippines, Poland, Portugal, Romania, Russia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Thailand, Turkey, Ukraine, United Kingdom, Uruguay and Vietnam.

Note by Turkey: The information in this document with reference to “Cyprus” relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the “Cyprus issue”.

Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

The Bruno and Shin (2013) study includes three of G4 currency issuing economies (euro area, Japan and the United Kingdom). Some comments regarding this paper suggested the exclusion of these economies as they would contrast with the other economies that do not issue international currencies. This was not accepted for two reasons: first, to follow Bruno and Shin (2013) to the letter; and second, to ensure as much diversity in the data as possible to ensure more robust results (no data mining).

22. Although a single country specific behaviour is assessed against a similar (not exactly identical) panel benchmark of 48 remaining countries, all cross-country comparisons are done considering the level of significance and the related sign of coefficients and not their estimated value or elasticities.
23. See Table A1.2 for further details regarding the list of countries which are using CFMs.
24. For example, a country with the average emerging country total effect coefficient of -0.05 subjected in one quarter to a standard deviation move up of 0.29, would see approximately a -1.5% contraction in external loans most likely reversed within one or two quarters. Contrast this with an emerging country with the average coefficient of -0.08 subject to a sustained standard deviation rise of 0.34 in the VIX variable. This would lead to a fall in external loans of -2.7% and would be much more likely to be sustained.
25. The sample includes 27 advanced economies (Australia, Austria, Belgium, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Japan, Latvia, Lithuania, Malta, Netherlands, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom) and 22 emerging economies (Argentina, Brazil, Bulgaria, Chile, China, Egypt, Hungary, Iceland, Indonesia, Israel, Korea, Malaysia, Mexico, Philippines, Poland, Romania, Russia, Thailand, Turkey, Ukraine, Uruguay and Vietnam).
26. The national applications of the Basel Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR), including by currency, as alternatives to CFMs used with a macro-prudential intent are being discussed by the OECD’s Advisory Task Force on the OECD Code of Liberalisation of Capital Movements.

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ANNEX A1

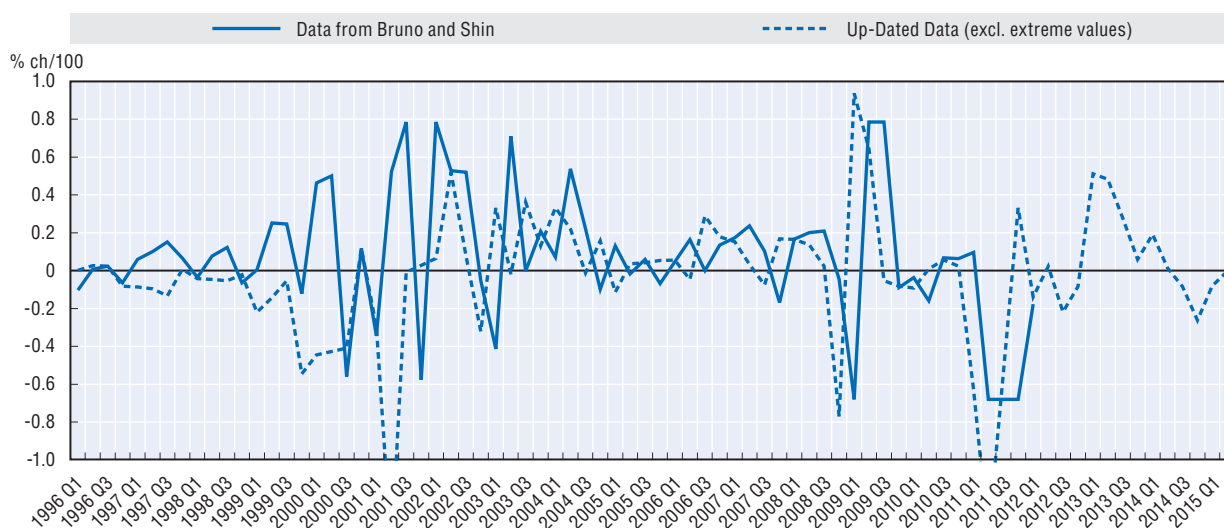
Verifying the Bruno and Shin (2013) result and updated results

To analyse the study of Bruno and Shin (2013), the first step was to verify the results. The original data was requested and provided by the authors. The regressions were re-run and the results were reproduced, ensuring that the model framework is being faithfully reproduced by the current authors.

However, the interoffice data are subject to revisions (see Figure A1.1). These revisions give rise to a series somewhat different to that used by Bruno and Shin, particularly in the periods 1996-2001 and 2008-10.¹ It is worth noting that the interoffice variable appears to be highly unsuitable for taking quarterly percentage changes (in both the original study and the revised data). This is because the Fed series involves negative numbers and crosses the zero line in levels twice in the sample giving rise to distortions.²

Nevertheless, the data were updated and a few extreme observations around cross-over points were removed and replaced by interpolated data for use in the panel study. The results using the updated data over the same sample period as in Bruno and Shin (2013) are shown for their country of focus in Table A1.1. The revised data affect the β coefficients in

Figure A1.1. **The growth in net interoffice liabilities of foreign banks in the United States**



Note: Two extreme observations are removed.

Source: Bruno and Shin (2013), Board of Governors of the Federal Reserve System, Series H8 on commercial banks (data updated on 22 July 2015).

a meaningful way. In particular, β_2 changes sign to a negative (the whole panel is less sensitive to interoffice post-2010), and this result is much more strongly supported by the data than the positive coefficient in the original study. The negative β_4 result specific to their country of focus is confirmed. However, the sensitivity to the global credit cycle appears to have increased compared to the original study – in particular, γ_4 is negative and significant at the 1% level (as opposed to being insignificant in Bruno and Shin, 2013). This is not encouraging for the possible macro-prudential benefits of the focus country's measures in 2010. The full tests are carried out for both advanced and emerging countries in the longer sample period in the following section.

Table A1.1. Replication of the results obtained by Bruno and Shin (2014) using up-dated data for Δ INTER, over the period 1996 Q1 to 2012 Q1

Coeff.		[1]	[2]	[3]	[4]	[5]
β_1	Δ INTER	0.0195*** (3.65)	0.0192*** (3.58)	0.0348*** (5.42)	0.0195*** (3.65)	0.0153** (2.64)
β_2	Δ INTER * Post 2010			-0.0579*** (-5.38)		
β_3	Δ INTER * Country		0.0131*** (3.07)	0.0362*** (6.83)		
β_4	Δ INTER * Post 2010 * Country			-0.0850*** (-11.96)		
γ_1	VIX	-0.0705*** (-7.96)	-0.0705*** (-7.96)	-0.0530*** (-5.49)	-0.0693*** (-7.87)	-0.0774*** (-7.92)
γ_2	VIX * Post 2010					0.0142*** (3.65)
γ_3	VIX * Country				-0.0670*** (-11.03)	-0.0666*** (-11.32)
γ_4	VIX * Post 2010 * Country					-0.0243** (-2.12)
δ_1	Δ VIX	-0.0355*** (-4.95)	-0.0355*** (-4.95)	-0.0350*** (-4.85)	-0.0355*** (-4.87)	-0.0311*** (-3.52)
δ_2	Δ VIX * Post 2010					-0.0147 (-1.26)
δ_3	Δ VIX * Country				-0.00636 (-1.08)	-0.0224*** (-3.43)
δ_4	Δ VIX * Post 2010 * Country					0.0300** (2.60)
	Country * Post 2010			-0.0106 (-1.18)		0.0822** (2.21)
	Δ RER	-0.0783** (-2.64)	-0.0783** (-2.64)	-0.0677** (-2.29)	-0.0759** (-2.61)	-0.0741** (-2.57)
	Δ M	-0.0771 (-1.19)	-0.0771 (-1.19)	-0.0945 (-1.44)	-0.0744 (-1.14)	-0.0712 (-1.09)
	GDP	0.200** (2.47)	0.199** (2.46)	0.200** (2.46)	0.201** (2.47)	0.201** (2.47)
	Δ Govt	-0.0732** (-2.29)	-0.0735** (-2.29)	-0.0743** (-2.30)	-0.0751** (-2.32)	-0.0752** (-2.31)
	C	0.204*** (7.73)	0.204*** (7.72)	0.156*** (5.41)	0.204*** (7.84)	0.226*** (7.91)
	Observations	2812	2812	2812	2812	2812
	R-Squared	0.127	0.127	0.134	0.129	0.133
	Number of countries	48	48	48	48	48
	Time and country fixed effects	Y	Y	Y	Y	Y

Note: This table presents panel regressions for bank capital flows to 48 countries. See the text for an explanation of the methodology and a description of the variables. Standard errors are clustered at the country level and are reported in parentheses.

Source: OECD calculations.

Enlarging the scope of the Bruno and Shin (2013) study to other countries

Table A1.2 shows the results of the extension of Bruno and Shin's (2013) methodology over the period 1996 Q1 to 2014 Q4 for other countries taken individually (i.e. 10 countries with no CFMs and 10 countries that have been using such measures at times during this period³). In addition, China (excluded in the Bruno and Shin study) is added to the sample, because it is the most important developing country, and is currently of strong interest to policy makers as it weighs the issues of capital controls, exchange rate management and convertibility.⁴ Table A1.3 reports the full set of F-tests for Δ INTER, VIX and Δ VIX. Rejection on the null hypothesis is indicated with asterisks (* at the 10% level, ** at the 5% level, and *** at the 1% level).

The results are as follows:

- With respect to inter-office: the results suggest $\beta_2 < 0$ for all countries. Following the crisis and regulatory change related to the Basel requirements it appears to be a global phenomenon that banking cross-border flows are less sensitive to interoffice. This makes some sense as Basel rules, local bank regulations and banks' own risk procedures have all moved to reduce vulnerability to unstable external dollar funding: $\beta_2 + \beta_4 < 0$ for most countries (with the exception of Argentina which is significantly more sensitive), including both advanced and emerging countries. In short, the Bruno-Shin result is confirmed for most countries suggesting the finding is a more global phenomenon than for their country of focus alone and is unlikely to be due to any specific macro-prudential measures. For $\beta_3 + \beta_4$ (i.e. the selected country is significantly different to the rest of the panel post 2010) the results are of course mixed, and there is no clear pattern as to whether advanced or emerging economies are more or less sensitive than the panel.
- The VIX results bear more directly on the macro-prudential issue concerning the global credit cycle. One very clear pattern that emerges is that large advanced countries with significant banking systems and/or deep liquid trading in their assets and liabilities (Germany, Switzerland, Japan and the United Kingdom) are significantly more countercyclical post-2010 with both $\gamma_2 + \gamma_4 > 0$ and $\gamma_3 + \gamma_4 > 0$. That is, they are less sensitive to the VIX in a countercyclical manner after 2010 and are they are less sensitive than the rest of the panel. Smaller financially open economies (Australia, Canada, Italy and Ireland) are more sensitive after the crisis. In economies that use CFMs, typically emerging economies, there is a very clear pattern of a worsening of the situation with respect to the global risk cycle post-2010: there is a post-2010 deterioration in 6 of the 10 countries ($\gamma_2 + \gamma_4 < 0$) and 7 of the 10 countries are more pro-cyclical than the full panel ($\gamma_3 + \gamma_4 < 0$). The total effect on these countries post-2010 is for deterioration ($\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4 < 0$) in all of the selected economies that use CFMs. Two countries (Iceland and Turkey) reduce their specific sensitivity post 2010 ($\gamma_2 + \gamma_4 > 0$), and only 1 (Chile) reduced its sensitivity versus the panel ($\gamma_3 + \gamma_4 > 0$). The clearest result is that the total effect for all of these CFM countries post 2010 is for significant deterioration. In short, global factors have likely made emerging economies more prone to variations in the credit cycle post-2010, and in this sense capital flow measures that are thought to have improved macro-prudential policy can hardly be thought of as having been effective.
- The situation for ΔVIX shows the advanced countries in the main being more sensitive to short-run swings in volatility, with the exception of Germany, Switzerland and Japan, which have all become less sensitive. For the selected CFM countries the main finding is that 8 of the 12 countries selected have total effects that are negative post 2010 (more sensitive to ΔVIX). While δ_4 is often positive this is not nearly enough to offset the significant negative findings for the other 3 parameters.

Table A1.2. Panel regressions on banks' capital flows considering alternately countries with or without cross border capital flow measures over the period 1996 Q1 to 2014 Q4

NO CROSS BORDER MEASURES	Australia	Canada	France	Germany	Ireland	Italy	Japan	Sweden	Switzerland	United Kingdom
β_1	0.0373***	0.0386***	0.0382***	0.0380***	0.0377***	0.0374***	0.0378***	0.0383***	0.0383***	0.0380***
β_2	-0.0604***	-0.0627***	-0.0623***	-0.0618***	-0.0623***	-0.0615***	-0.0626***	-0.0633***	-0.0625***	-0.0621***
β_3	0.0312***	-0.0315***	-0.0108*	-0.0025	0.0116**	0.0246***	0.0078	-0.0162***	-0.0165***	-0.0028
β_4	-0.0906***	0.0200***	-0.0022	-0.0243***	0.0008	-0.0361***	0.0167**	0.0490***	0.0078	-0.0106*
γ_1	-0.0826***	-0.0824***	-0.0823***	-0.0838***	-0.0832***	-0.0819***	-0.0844***	-0.0828***	-0.0829***	-0.0827***
γ_2	0.0142***	0.0142***	0.0142***	0.0140***	0.0144***	0.0143***	0.0136***	0.0142***	0.0139***	0.0141***
γ_3	0.0382***	0.0137**	-0.0012	0.0519***	0.0499***	-0.0110*	0.0811***	0.0288***	0.0014	0.0018
γ_4	-0.116***	-0.0662***	-0.0365***	0.0462***	-0.0702***	-0.0681***	0.0451***	-0.0574***	0.0865***	0.0392***
δ_1	-0.0317***	-0.0316***	-0.0305***	-0.0311***	-0.0314***	-0.0301***	-0.0307***	-0.0311***	-0.0311***	-0.0312***
δ_2	-0.0250**	-0.0229**	-0.0246**	-0.0262**	-0.0246**	-0.0237**	-0.0262**	-0.0245**	-0.0256**	-0.0246**
δ_3	0.0493***	0.0368***	-0.0116*	0.0114*	0.0325***	-0.0252***	-0.0056	0.0179***	0.0028	0.0129*
δ_4	-0.0309***	-0.109***	-0.0164	0.0946***	-0.0262**	-0.0779***	0.0797***	-0.0311***	0.0866***	0.0173*
R-Squared	0.147	0.146	0.146	0.146	0.146	0.146	0.147	0.146	0.146	0.146
	0.145	0.144	0.144	0.145	0.144	0.144	0.147	0.144	0.144	0.144
CROSS BORDER MEASURES	Argentina	Chile	China	Iceland	Indonesia	Israel	Korea	Malaysia	Thailand	Turkey
β_1	0.0405***	0.0391***	0.0369***	0.0378***	0.0380***	0.0386***	0.0372***	0.0376***	0.0382***	0.0373***
β_2	-0.0649***	-0.0633***	-0.0613***	-0.0622***	-0.0626***	-0.0631***	-0.0614***	-0.0618***	-0.0621***	-0.0620***
β_3	-0.124***	-0.0528***	0.0464***	0.0085*	-0.0021	-0.0353***	0.0362***	0.0171***	-0.0117*	0.0322***
β_4	0.131***	0.0454***	-0.0448***	-0.0066	0.0181***	0.0444***	-0.0418***	-0.0196***	-0.0096	-0.0130*
γ_1	-0.0835***	-0.0842***	-0.0813***	-0.0803***	-0.0820***	-0.0833***	-0.0812***	-0.0815***	-0.0821***	-0.0817***
γ_2	0.0141***	0.0141***	0.0136***	0.0146***	0.0136***	0.0141***	0.0141***	0.0140***	0.0136***	0.0139***
γ_3	0.0669***	0.103***	-0.0386***	-0.110***	-0.0133**	0.0613***	-0.0651***	-0.0187**	0.0054	-0.0369***
γ_4	-0.0597***	-0.0620***	-0.0362***	0.0128	-0.0112	-0.0655***	-0.0084	-0.0986***	-0.0664***	0.0077
δ_1	-0.0315***	-0.0317***	-0.0302***	-0.0291***	-0.0299***	-0.0312***	-0.0304***	-0.0281***	-0.0294***	-0.0305***
δ_2	-0.0257**	-0.0244**	-0.0248**	-0.0248**	-0.0256**	-0.0265**	-0.0250**	-0.0274**	-0.0263**	-0.0243**
δ_3	0.0384***	0.0508***	-0.0215***	-0.0800***	-0.0654***	0.0250***	-0.0221***	-0.105***	-0.0586***	-0.0198***
δ_4	0.0247*	-0.0405***	-0.0231**	0.0212**	0.0515***	0.0616***	0.0160	0.0658***	0.0339***	-0.0195*
R-Squared	0.149	0.146	0.151	0.148	0.149	0.146	0.146	0.147	0.151	0.147
	0.145	0.146	0.148	0.149	0.147	0.145	0.145	0.147	0.149	0.145

Note: This table presents panel regressions for bank capital flows to 49 countries. The dependent variable is bank capital flows measured by the quarterly log difference of external loans (Δ BANK; BIS Locational Banking Statistics Table 7A). Explanatory variables include the growth in interoffice assets, the VIX and the change in the VIX and their interactions with a time dummy for the period from June 2010 and a dummy for each country. Some control variables are also included. See text for explanation of methodology and variables' description. Standard errors are clustered at the country level and are reported in parentheses. Data are from 1996 Q1 to 2014 Q4.

Source: OECD calculations.

Table A1.3. F-tests for coefficient restrictions in Table A1.2.

NO CROSS BORDER MEASURES	Australia	Canada	France	Germany	Ireland	Italy	Japan	Sweden	Switzerland	United Kingdom
$\beta_2 + \beta_4$	-0.151 ***	-0.0427 ***	-0.0645 ***	-0.0861 ***	-0.0615 ***	-0.0976 ***	-0.0459 ***	-0.0143	-0.0547 ***	-0.0727 ***
$\beta_3 + \beta_4$	-0.0594 ***	-0.0115 ***	-0.013 ***	-0.0268 ***	0.0124 ***	-0.0115 ***	0.0245 ***	0.0328 ***	-0.0087 **	-0.0134 ***
$\beta_1 + \beta_2 + \beta_3 + \beta_4$	-0.0825 ***	-0.0356 ***	-0.0371 ***	-0.0506 ***	-0.0122	-0.0356 ***	-0.0003	0.0078	-0.0329 ***	-0.0375 ***
$\gamma_2 + \gamma_4$	-0.1018 ***	-0.052 ***	-0.0223 ***	0.0602 ***	-0.0558 ***	-0.0538 ***	0.0587 ***	-0.0432 ***	0.1004 ***	0.0533 ***
$\gamma_3 + \gamma_4$	-0.0778 ***	-0.0525 ***	-0.0377 ***	0.0981 ***	-0.0203	-0.0791 ***	0.1262 ***	-0.0286 ***	0.0879 ***	0.041 ***
$\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4$	-0.1462 ***	-0.1207 ***	-0.1058 ***	0.0283 **	-0.0891 ***	-0.1467 ***	0.0554 ***	-0.0972 ***	0.0189 *	-0.0276 **
$\delta_2 + \delta_4$	-0.0559 ***	-0.1319 ***	-0.041 ***	0.0684 ***	-0.0508 ***	-0.1016 ***	0.0535 ***	-0.0556 ***	0.061 ***	-0.0073
$\delta_3 + \delta_4$	0.0184 **	-0.0722 ***	-0.028 ***	0.106 ***	0.0063	-0.1031 ***	0.0741 ***	-0.0132	0.0894 ***	0.0302 ***
$\delta_1 + \delta_2 + \delta_3 + \delta_4$	-0.0383 ***	-0.1267 ***	-0.0831 ***	0.0487 ***	-0.0497 ***	-0.1569 ***	0.0172 ***	-0.0688 ***	0.0327 ***	-0.0256 ***
CROSS BORDER MEASURES	Argentina	Chile	China	Iceland	Indonesia	Israel	Korea	Malaysia	Thailand	Turkey
$\beta_2 + \beta_4$	0.0661 ***	-0.0179 *	-0.1061 ***	-0.0688 ***	-0.0445 ***	-0.0187 **	-0.1032 ***	-0.0814 ***	-0.0717 ***	-0.075 ***
$\beta_3 + \beta_4$	0.007 *	-0.0074 *	0.0016	0.0019	0.016 ***	0.0091 **	-0.0055	-0.0025	-0.0213 ***	0.0192 ***
$\beta_1 + \beta_2 + \beta_3 + \beta_4$	-0.0174 **	-0.0316 ***	-0.0228 ***	-0.0225 **	-0.0086	-0.0154 *	-0.0298 ***	-0.0267 ***	-0.0452 ***	-0.0055
$\gamma_2 + \gamma_4$	-0.0456 ***	-0.0479 ***	-0.0226 **	0.0274 ***	0.0024	-0.0514 ***	0.0057	-0.0846 ***	-0.0528 ***	0.0216 **
$\gamma_3 + \gamma_4$	0.0072	0.041 ***	-0.0748 ***	-0.0972 ***	-0.0245 ***	-0.0042	-0.0735 ***	-0.1173 ***	-0.061 ***	-0.0292 ***
$\gamma_1 + \gamma_2 + \gamma_3 + \gamma_4$	-0.0622 ***	-0.0291 **	-0.1425 ***	-0.1629 ***	-0.0929 ***	-0.0734 ***	-0.1406 ***	-0.1848 ***	-0.1295 ***	-0.097 ***
$\delta_2 + \delta_4$	-0.001	-0.0649 ***	-0.0479 ***	-0.0036	0.0259 ***	0.0351 ***	-0.009 *	0.0384 ***	0.0076 ***	-0.0438 ***
$\delta_3 + \delta_4$	0.0631 ***	0.0103	-0.0446 ***	-0.0588 ***	-0.0139	0.0866 ***	-0.0061	-0.0392 ***	-0.0247 ***	-0.0393 ***
$\delta_1 + \delta_2 + \delta_3 + \delta_4$	0.0059	-0.0458 ***	-0.0996 ***	-0.1127 ***	-0.0694 ***	0.0289 ***	-0.0615 ***	-0.0947 ***	-0.0804 ***	-0.0941 ***

Note: This table presents F-tests for coefficient restrictions in Table A1.2. Sum of coefficients are reported and *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. The null hypothesis $\beta_2 + \beta_4 = 0$ is the statement that there is no change in sensitivity of capital flows into a given country with respect to Δ INTER variable after June 2010. The null $\beta_3 + \beta_4 = 0$ corresponds to the statement that there is no difference between a given country and other countries in their sensitivity to Δ INTER variable after June 2010. γ and δ coefficients are for the other global factors VIX and Δ VIX, respectively.

Source: OECD calculations.

Notes

1. The data are based on samples of banks that are affected by failures and mergers and acquisitions. The Federal Reserve reallocates assets and liabilities for banks taking over another bank. Where a bank exits the banking universe it is replaced by the next bank in line, and a ratio method is used to adjust past levels to ensure historical consistency.
2. In fact the Federal Reserve explicitly warns about using percentage changes for this variable because with negative levels “the resultant percent changes are difficult to interpret”.
3. Indicators measuring capital account openness and scoring country regulatory restrictiveness toward capital flows are the matter of on-going work at the OECD and other institutions. Econometric results using the approach in this paper may be sensitive to these indicators as they will be improved over time.
4. Robustness checks have been performed by running Bruno and Shin’s (2013) model with China in addition to the list of 48 countries over the period 1996 Q1 to 2012 Q1. All the results are remaining stable. Detailed results are available upon request.

ANNEX A2

A simplified illustration of the prudential issues for banks caused by CFMs and where Basel-inspired measures would fit in

The focus is one of extreme simplicity with snapshots of theoretical bank balance sheet sequences at certain points in a speculative process shown in Table A2.1, labelled (A) to (F). The focus is on the case of downward pressure on the exchange rate.¹

Sequence (A): No macro-prudential rule and no speculation

The example labelled (A) starts with a simple balance sheet of 500bn local currency, with an exchange rate $S = 5$ to the US dollar (local currency per unit of the dollar). There is a 5% leverage ratio requirement, and the bank holds 250bn of capital. It has USD 100bn non-core dollar funding, equivalent to 500bn local currency, and it has 4250bn in core stable deposits. There are no derivatives on the bank portfolio at this initial point.

Sequence (B): Speculation of expected profit in the forward market emerges

The forward rate F is tied to the spot rate S by the covered interest parity relationship:

$$F = S(1+R)/(1+R^*)$$

R is the local currency interest rate, and R^* the US dollar yield. If the dollar interest rate is 2% and the local rate is 5%, then the forward rate is 5.15. Now suppose speculators come to believe that the future spot rate $S(t+1)$ will move to 6 for the US dollar, due to an expected external real shock (such as a downward movement in the terms of trade) and it is currently out of line with the forward rate. They write forwards at today's price to deliver local currency in the future (when it should be cheaper). There are no capital flows taking place as such; rather the contracts are to be settled in P&L terms depending on the outcome. They strike contracts which if realised will make expected profits according to:

$$\text{Profit (exp)} = [S(t+1) - F(t)]Q(t)$$

They strike 500 forward contracts $Q(t)$ and the bank makes a market for them. The expected profit is 426bn, i.e. $(6 - 5.15) \times 500$. The bank will always match its book, and it strikes offsetting contracts with other banks or shadow banks. The bank's stress-tested matched book would look like Case (B). At this theoretical point the bank would be short 21bn in capital².

Sequence (C): 20% depreciation (the spot rate moves to the expected future level)

It is assumed that the central bank allows the exchange rate to move freely – and the speculators will prove to be right. The spot rate and the forward rate would move back into equilibrium around the weaker exchange rate. This is because, unless the central bank intervenes in the forward market, banks in the system cannot all do the same thing to match their books in the face of an open speculative position, and so activity spills into the spot market in the form (for example) of:³

- banks borrowing local currency and selling it for dollars to replicate the required cover (as noted above); or
- banks engaging in a swap of dollars for local currency to be reversed at the contractual future date. The local currency is then sold to buy the dollar. At the future date the trade replicates the forward market performance (the local currency is purchased for delivery at a cheaper price) while the dollars from the swap are received in the reversal of the swap.

The speculators close out their positions, with no derivatives risk to the bank, and the spot rate moves to 6. However, this 20% depreciation increases the liabilities of the bank by 100bn, and it now has a severe problem. It has in effect a 100bn capital shortfall, the write-off of which will see it not meeting its regulatory requirement of 5% of its assets. It will need to raise more equity and/or move into deleveraging. The bank also risks a non-core dollar funding withdrawal – a particularly since typically the debt securities involved are of shorter duration than its asset portfolio and it will face debt rollover periods which do not have to be renewed. This could rapidly turn into a serious crisis.

Alternative Sequence (D): No Open Position rule

A simple prudential rule would be one of no open positions which addresses currency mismatch. In this case the bank would also have to hold dollar assets equal to the dollar funding, and with the 20% depreciation and all derivatives closed out the position would look like case (D). This does not restrict capital flows since both sides of the balance sheet can move up and down, and it is the role of the central bank to adjust monetary policy to deal with the domestic credit cycle associated with the banks total credit portfolio (which it can best do with a flexible exchange rate). With such a rule the bank capital does not appear to be at risk from currency mismatch (a macro-prudential concern).⁴ However, this ignores possible extremes of maturity mismatches. For example, as banks are in the business of maturity transformation, they could fund large positions in overnight money and hold an offsetting portfolio of subprime SIVs that are totally illiquid. In a crisis the bank could see its overnight funding disappear, while it could not liquidate the illiquid assets.

Table A2.1. **Sequence examples arriving at a Basel-consistent solution**

(A) No Macro-prudential part \$ Funding			(B) A 20% expected depreciation		
	Asset	Liability		Asset	Liability
On B/S core	5 000	4 250	On B/S core	5 000	4 250
<i>Non-core \$ funding (\$LCR)</i>	0	100	<i>Non-core \$ funding (\$LCR)</i>	0	100
Local value \$ funding	0	500	Local value \$ funding	0	500
Fair value derivatives +ve	0		Fair value derivatives +ve	426	
Fair value derivatives -ve		0	Fair value derivatives -ve		426
Equity \$ assets/liab		250	Equity \$ assets/liab		250
Total \$ assets/liab	5 000	5 000	Total \$ assets/liab	5 426	5 426
LEV RATIO		5%	LEV RATIO		5%
Required equity \$		250	Required equity \$		271
Assets-liabilities		250	Assets-liabilities		250
Gap to required		0	Gap to required		-21
(C) Crisis scenario 20% depreciation			(D) Imposing a "no open position rule"		
	Asset	Liability		Asset	Liability
On B/S core	5 000	4 250	On B/S core	4 500	4 250
<i>Non-core \$ funding (\$LCR)</i>	0	100	<i>Non-core \$ funding (\$LCR)</i>	100	100
Local value \$ funding	0	600	Local value \$ funding	600	600
Fair value derivatives +ve	0		Fair value derivatives +ve	0	
Fair value derivatives -ve		0	Fair value derivatives -ve		0
Equity \$ assets/liab		150	Equity \$ assets/liab		250
Total \$ assets/liab	5 000	5 000	Total \$ assets/liab	5 100	5 100
LEV RATIO		5%	LEV RATIO		5%
Required equity \$		250	Required equity \$		255
Assets-liabilities		150	Assets-liabilities		250
Gap to required		-100	Gap to required		-5
(E) Fwd Speculation with NSFR & LCR			(F) Result with 20% deprec. & NSFR & LCR		
	Asset	Liability		Asset	Liability
On B/S core	4 750	4 500	On B/S core	4 750	4 500
<i>Non-core \$ funding (\$LCR)</i>	50	50	<i>Non-core \$ funding (\$LCR)</i>	50	50
Local value \$ funding	250	250	Local value \$ funding	300	300
Fair value derivatives +ve	426		Fair value derivatives +ve	0	
Fair value derivatives -ve		426	Fair value derivatives -ve		0
Equity \$ assets/liab		250	Equity \$ assets/liab		250
Total \$ assets/liab	5 426	5 426	Total \$ assets/liab	5 050	5 050
LEV RATIO		5%	LEV RATIO		5%
Required equity \$		271	Required equity \$		253
Assets-liabilities		250	Assets-liabilities		250
Gap to required		-21	Gap to required		-2

Sequences (E) & (F): Speculation to drive the currency down with NSFR and LCR

These currency and maturity mismatch risks may be dealt with in a manner consistent with the Basel framework utilising the basic ideas of the NSFR and the currency composition of the LCR. After all of its stress testing, the example here assumes that the authorities decide:

- To limit the amount of short-term funding with a “NSFR” of the form that the bank be asked to keep the domestic currency value of its dollar funding at (say) 5% of its stable core deposits. The initial balance sheet of 5000 now made up of 4500 core deposits, 250 local currency value of overnight non-core funding (half that of case (A)), and 250 capital. This rule is not really necessary to address mismatch, but may be used.
- Via an LCR-type rule (which is necessary) the bank must hold dollar assets of an equivalent amount, and with a maturity composition that can be liquidated if foreign funding is withdrawn rapidly in a crisis scenario. While not shown here, the dollar assets in the “LCR” have the stress-tested liquidity characteristics required by the regulator.
- This is shown as case (E), where forward speculation of a move to a future spot rate of 6 is also shown (for the sake of brevity in the use of tables). Case (F) shows the speculators closed derivative positions and the exchange rate moving to 6. The foreign currency positions move to 300 (smaller than in example (D)), currency matched, and the composition of the LCR is designed to be able to deal with stress-tested withdrawal of foreign short-term funding in a crisis.

Summary

This analysis indicates that there is no need to impose long-term CFMs in the form of limits on banks’ foreign exchange derivative positions for prudential reasons, as banks match their books and the Basel system has a CVA capital charge for counterparty credit risk. For the rest of the balance sheet, addressing risks involving foreign currency borrowing and possible mismatches, one might usefully explore the Basel pre-emptive prudential frameworks. They would appear to address prudential concerns directly without excessive restrictions on capital movements. Bank-intermediated foreign currency funding and assets can move up and down with the overall size of the bank balance sheet, provided the prudential relative requirements are respected.

Notes

1. Equivalent examples could be constructed for the low VIX scenario with upward pressure on the exchange rate.
2. This is not the correct CVA charge used for derivatives – it is a simplification to remind the reader that capital charges apply to such trades.
3. One benefit of imposing an absolute restriction on derivatives could be to reduce the amount of foreign exchange intervention in the forward spot markets needed to reduce exchange rate volatility.
4. Notice that this does not limit capital flows. It is a pure prudential measure separate from limits on capital flows associated with other policy concerns.



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