OECD Journal: Financial Market Trends 2014
Volume 2013/2

Macro-prudential policy, bank systemic risk and capital controls

by
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The paper explores the issue of macro-prudential policies in the light of empirical evidence on the determinants of bank systemic risk, and the effectiveness of capital controls. In many ways this reflects a step back in time towards sector approaches to monetary policy that were so prevalent in the 1960s, 1970s and early 1980s. Complexity and interdependence is such that proposals on these issues should be treated with care until much more is understood about the issue.

JEL Classification: C23, C25, F21, F43, G01.

Keywords: Macro-prudential policies, capital controls, economic growth, emerging economies, financial crisis.

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I. Introduction

The first references to macro-prudential policy were in closed meetings, such as in the Cooke Committee in 1979,[1] which was the forerunner of the Basel Committee of Banking Supervision (BCBS). The chairman noted that micro-prudential issues were being interfaced with macro-prudential issues. The concern was about bank lending globally in the face of high oil prices. He attempted to draw the boundary of supervisory interest as not in the macroeconomic problems per se, but how the latter had (and could) lead to bank problems not treatable with micro regulation. Lamfalussy around the same time explained that macro-prudential issues are problems that bear on the market as a whole, and may not be obvious in individual banks at the micro prudential level. The first public appearances of the term were in the Euro-currency Standing Committee (ECSC) report, and in the Cross Report (BIS, 1986) where it merits an entire chapter. The introduction to the report launches into bank risks that are related to innovations, capital markets banking, derivatives, securitisation, large bank off-balance-sheet responses to investment banks, liquidity risk, and the under-pricing of risk. These developments might cause concerns – such as technology failures, the evaporation of liquidity in a crisis situation, and problems with counterparty risk that could have macro consequences and negative feedback loops on the macro economy. In short, the Cross Report sets on the table all the topics that were never adequately dealt with in subsequent years, and which resulted in the global financial crisis (GFC) of 2008 until the present.

The term "macro-prudential" has taken on new meanings in more recent years. In the late 1990s, following the Asia crisis, the IMF focused more on the term and included indicators for it in their Financial Sector Assessment Program (FSAP) reports. The sense appears to be for a need to monitor financial developments that might lead to macroeconomic problems. A clearer definition of the macro-prudential term appears in Crockett (2000), who saw two strands to it: *i)* the pro-cyclicality of the financial cycle, which called for a build-up of cushions in good times that could be run down in bad times (stabilisers); and *ii)* institutions having similar exposures being interconnected with each other, which calls for the calibration of prudential tools with respect to the systemic importance of individual institutions. Crockett sees the distinction between macro- and micro-prudential not in terms of the type of instruments, but rather in "*the objective of the tasks and the conception of the mechanisms influencing economic outcomes*." This seems a reasonable goal, but a decade or so later the FSB conceptualises it more narrowly. In its 2011 paper on macro-prudential policy tools and frameworks the FSB defines macro-prudential policy as one that "uses prudential tools to limit systemic or system-wide financial risk" (FSB, 2011).

This is precisely where the problems start. If prudential tools are to be used for micro and macro policy objectives then governance problems are going to become inevitable. Worse still, there may be conflicts in policy objectives whereby governments are lured into the belief that if it is not politically popular to get internal and external balance

fundamentals right, then somehow these policy tools might be able to act as a way to square the circle. There are two broad strands to these thoughts:

- Monetary and fiscal policy failed to prevent the financial crisis at the systemic level, so now they are to be augmented by some prudential tools in the expectation that together they can succeed.
- The financial crisis and policies to deal with it in advanced economies, including low rates and quantitative easing, have had spill-over effects in emerging market economies (EMEs), and it has become fashionable to believe that perhaps capital controls can be used to resolve these problems.

This paper looks first at the concept of macro-prudential policy and the requirements for its successful use in Section II: identification, calibration, tools, the potential conflicts in objectives and the governance issues. Section III then provides some empirical evidence pertaining to the efficacy of macro-prudential policy to contain systemic risk in advanced economies, focusing on complexity and interdependence. The paper then explores the usefulness of capital controls in emerging economies as a macro-prudential tool. Finally, some concluding remarks are provided in Section V.

II. Macro-prudential tools to counter systemic risk

II.1. Overview

There is enormous support for the idea that asset prices and the credit cycle have strong implications for systemic stability, and that there are limits to what inflation-focused monetary policy can achieve on its own. White (2012) focuses on the current monetary ease, which could have unintended consequences. Macro policy needs to lean more heavily into the wind and governments should use whatever tools they have in the current crisis to help restore macro equilibrium given the limits to what central banks can do. Borio (2012) reviews a wide range of literature and events and asks what we have learned from boom bust financial cycles. He focuses particularly on the interaction between credit and property prices: these are associated with cycles of wide amplitude and long duration compared to GDP, and they are inextricably linked with financial crises. Borio suggests modelling this with new approaches to the cycle in risk attitudes which are only loosely linked to underlying values and fundamentals (as opposed to model-consistent expectations in models). This fits nicely with the idea of macro-prudential policy, and the need to build buffers in good times and to run them down in bad times.

The process of financial deregulation recognised that monetary policy cannot operate via regulations and controls affecting sector behaviour, as used to be the case prior to the early 1980s. This combination of interest rate policy combined with a number of the old tools now being revived in the macro-prudential lists, and some new ones, is in some sense a step back in time. The new macro-prudential advocates appear to want to influence sector behaviour again, as such behaviour has been associated with systemic risks. In some sense the belief appears to be that the old tools and re-regulation, perhaps if used in a more intelligent way, may help better to achieve macro stability objectives in the future.

The main causes of systemic risk are financial institutions that engage in three broad activities: *i*) credit intermediation; *ii*) maturity transformation; and *iii*) leverage. These activities extend well beyond banks, to what has been referred to as the shadow banking system, including importantly: hedge funds, insurance companies, real estate investment

trusts (REITS), exchange traded funds, OTC derivatives, etc. The complexity is enormous, and the macro-prudential policy maker must be able to carry out four quite basic steps:

- The ability to identify imbalances before they become a problem.
- Select the appropriate prudential tool, or tools.
- Decide how to calibrate (data and modelling) and time the intervention.
- Co-ordinate all the responsible regulators and supervisors to bring it about, including achieving political support for the actions – and since the tools may vary from one situation to the next, a macro-prudential regulator will need to be involved in the co-ordination at both the domestic and international levels.

II.2. Identifying imbalances early

With respect to the first of these basic steps, the track record is very poor. Fundamentals are changing and innovations occur at such a pace that it has always proven difficult to decide what portion of the asset cycle is a fair value shift and what part is due to excess. These problems are particularly extreme in typical EMEs, where strong investment demand must be financed and financial intermediation is in the early stages of development.

II.3. Choosing appropriate tools

The second requirement is to choose the appropriate tools. Even if authorities believe they can identify excess before it emerges, there is a vast number of tools that can be assigned, and different countries continue to choose those with which they are politically more comfortable. Some of these operate on relative prices and some on quantities.

For influencing financial institution balance sheets, where solvency and liquidity risks might be the source of systemic stability concerns, the policy tools include inter alia:

- counter-cyclical capital buffers;
- time varying systemic surcharges;
- systemic capital surcharges;
- systemic liquidity surcharges and supporting measures such as caps on loan-to-deposit ratios, the liquidity coverage ratio (LCR) the net stable funding ratio (NSFR);
- capital surcharges on OTC derivatives not cleared centrally;
- a capital surcharge for global systemically important financial institutions (GSIFIs);
- varying the capital plans of individual banks after stress testing exercises; and
- dynamic provisioning.

Where non-bank borrowers and financial institution lenders are judged to be taking excessive risks the available tools include:

- variations in loan-to-value ratio requirements for mortgages (linked to the house price cycle);
- imposing caps on the ratio of debt-service-to-disposable-income ratios;
- setting rules to avoid currency mismatches for borrowers and lenders;
- ceilings on credit growth; and
- rules on the reference interest rates for mortgage lending.

Where international interconnectedness issues are judged to be a source of instability in the domestic economy due to spill-overs – such as the current low rates in many OECD economies and quantitative easing policies by major central banks, the tools include:

- cross-border supervision; and
- controls on international capital flows (with an emerging market economy focus).

Where counterparty risk and complex network effects are a source of systemic concern the favoured tools seem to be:

- through-the-cycle variation of haircuts and margins.
- limits on interbank exposures.
- variations in Basel risk weights, such as the CVA charge; and
- transactions taxes.

II.4. Data, models and calibration

The third requirement for successful macro-prudential policy is to be able to link the surveillance data and tools with models that correctly calibrate them and time interventions without creating new problems because of complexity and interdependence – interactions that are not well understood. The very influential Geneva Report (Brunnermeier et al., 2009) is a good example of an attempt at the assignment issues in macro-prudential policy. The authors of the report propose the following:

- Micro-prudential policy consists of the Basel rules with a focus on the individual institutions, together with micro supervision. The domain of macro-prudential policy are large systemic institutions that are too big to fail (TBTF), and activities brought into effect by covariance issues, such as herding behaviour. Insurance companies and smaller institutions ("tinies") are left out of the macro-prudential policy maker's role.
- The central bank should have responsibility for macro-prudential policy, and the other supervisor for micro-prudential policy (working in the context of co-ordination, with BCBS, FSB, etc.).
- The objective is to lean against the wind in the face of the macro-prudential assessed risk, based on: expanding leverage, rising maturity mismatch, excessive bank credit expansion, and asset price bubbles.
- The macro-prudential tool is the core-Tier 1 Basel ratio. Then a cyclical buffer or capital charge will be calibrated with a coefficient on that ratio relating it to the assessment of the macro-prudential risk.
- Real estate is singled out for special thought, and loan-to-value ratio caps are seen as a useful macro-prudential tool.
- Accounting issues and their links with liquidity are also stressed. A mark-to-funding valuation of assets is recommended, instead of mark-to-market – the latter applies with greater weight for very short-term funding and the weight on hold-to-maturity valuation rises for very long duration assets.

Goodhart, one of the authors of the Geneva Report, has argued more recently (Goodhart, 2011) that the first macro-prudential tool that a central bank should use is its own balance sheet – buying and selling claims on the public sector, the private sector and the foreign sector when it perceives asset cycles are a risk to macro stability.

II.5. Governance of the targets and instruments

With regard to the fourth requirement for successful macro-prudential policy, governance, it is likely that co-ordination issues will be problematic. The supervisors for banks and all of the shadow banks are different in most jurisdictions, and include central banks, prudential regulators, consumer protection agencies, federal level regulators, state level regulators and international regulatory bodies. The responsibility for any one of the above list of tools varies widely from one jurisdiction to the next, and there are overlaps of responsibilities within and between countries.

Furthermore, systemic problems are global in nature, yet data collection for surveillance tends to be on a national basis. The FSB has recently tried to survey the data collection problems for the shadow banking sector, for example, and has discovered many problems. First not all shadow banks may engage in risky activities that are of systemic concern, but since there are data gaps it is difficult to know what is and what is not a problem. For example, hedge funds are estimated to have USD 7 tn under management, but data is not collected in all jurisdictions and little is known about their activities at a granular level. Furthermore, little is known about the interconnectedness of banks and shadow banks. Yet if the world is to move back into regulation with macro goals in mind, knowledge of these interactions will be crucial, since regulations tend to lead to avoidance strategies by financial companies that create new forms of disintermediation.

III. Evidence on the efficacy of macro-prudential policy in advanced economies

III.1. Macro-prudential policy and distance-to-default (DTD)

The empirical work presented in the following (based on Blundell-Wignall and Roulet, 2012) looks at the effects of the macro cycle and business model features of banks on their systemic riskiness, and the complex interaction of these factors bears directly on the macro-prudential and monetary policy debate. The sample in this analysis includes large banks that have systemic importance. The measure of the riskiness of banks used in this empirical work is the distance-to-default (DTD), which employs a combination of bank reported data and market information to calculate the number of standard deviations a bank is from the default point. The default point occurs where the market values of assets equals the book value of debt (a standard deviation of zero). The formula to calculate the DTD is derived from the option pricing model of Black and Scholes (1973).[2]

A panel regression approach is used to explain the differences in DTDs across banks over the period 2005-2012. The sample consists of the top G20 internationally active commercial banks and broker-dealer banks by equity market capitalisation, for those banks where all the data required is available. In addition, six banks that failed in the crisis, but which can be considered as GSIFIs, HBOS, Merrill Lynch, Lehman Brothers, Washington Mutual, Wachovia and Bear Stearns are included. This is essential, as they are the main banks of size whose assets were absorbed by others included in the sample – they act essentially as dummy variables for the M&A activity involved that would otherwise distort the results with breaks in the data on leverage ratios, etc. There are a total of 90 banks in the sample, consisting of 26 FSB GSIFI banks (excluding non-listed banks), 6 failed former GSIFI banks, and 58 other large banks.

The empirical model takes account of systemic importance, leverage, and business model aspects. The model is estimated with two alternatives for leverage: the leverage ratio and the regulatory capital approach of the Basel Tier 1 ratio. The variables and results

are shown in Table 1. LEV corresponds to the simple leverage ratio (total assets TA divided by core equity, with no risk weighting of assets, no netting of derivatives; US bank leverage is based on IFRS conversions), which is expected to have a negative sign. T1 is the Basel Tier 1 ratio based on risk-weighted-assets (T1/RWA), which is expected to have a positive sign. TD is the sum of the trading book and available-for-sale securities, and is expected to have a positive sign. The reason for this is that liquidity drives the banks' path to default in practice, when margin and collateral calls cannot be met. Liquid assets can be sold or used as collateral making a bank safer. WFD refers to wholesale funding as a share of total liabilities and is expected to have a negative sign – higher wholesale funding typically at a shorter duration is less stable than deposits for funding longer term assets.[3] GMV refers to the gross market value of derivatives as a share of the banks' total assets – appropriately converting all US banks to the IFRS concept for consistency. GMV is expected to have a negative sign – this is the quintessential interconnectedness variable where volatility drives rapid changes in margin requirements. BETA is a systemic importance variable, defined as the covariance of the firm's stock price with the national stock market, using daily data to calculate annual observations, divided by the variance of the national stock index. It is expected to have a negative sign, on the grounds that the firm is more connected to the national macro and asset price cycle. Finally, %HPI refers to the annual percentage change in the national house price index, and is expected to have a positive sign as rising prices improve a borrower's equity in the home and vice versa.

Table 1. **Determinants of bank distance-to-default: Multivariate panel results**

	All banks		G-SIFIs banks	Other large banks
Constant, α	8.17***	6.74***	11.21***	6.55***
	(7.15)	(4.75)	(6.94)	(8.72)
LEV: TA/Bank Equity	-0.04***	-	-0.03***	-0.05***
	(-3.30)		(-3.21)	(-2.53)
T1: Basel Tier 1 Ratio	-	2.24	-	-
		(0.58)		
TD: Trading Book plus Available for Sale Securities/TA	4.51 **	3.72	3.34 **	3.79
	(2.06)	(1.47)	(2.16)	(1.51)
WFD: Wholesale Funding/Total Liabilities	-4.14***	-4.54 **	-6.78***	-1.81
	(-3.04)	(-2.31)	(-2.47)	(-1.30)
GMV: GMV of Derivatives/TA	-3.48***	-5.39 **	-4.79***	-3.26
	(-2.42)	(-2.21)	(-3.02)	(-0.37)
BETA: CoVar Bank Stock Ret. with Ntl. Mkt Ret./Var. Mkt	-1.47***	-1.33***	-2.61***	-1.21***
	(-5.36)	(-3.61)	(-4.75)	(-3.47)
%HPI: House Price Index ann. % change	16.29***	17.45***	20.10***	17.32***
	(4.98)	(4.12)	(6.70)	(4.75)
R2	0.69	0.65	0.73	0.67
Fisher Statistic	11.25	9.47	12.58	9.76
P-Value F	0.00	0.00	0.00	0.00
Total Observations	569	569	201	368
VECM 1-year lagged residual (Engel & Granger test)	-0.85***	-0.85***	-0.78***	-0.90***
	(-17.72)	(-18.01)	(-11.05)	(-14.20)

Note: This table shows the results of estimating multivariate regressions for an unbalanced panel of 9 internationally active commercial banks and broker dealers in G20 countries with equity market capitalisation in excess of USD 5 bn over the period 2005-12. Cross-section and time fixed effects are used in the regressions as is the White diagonal covariance method. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. The VECM error correction results show adjustment of the current DTD to the previous year gap between the predicted and actual values, allowing one lagged innovation in the standard model (see Ericsson and Mackinnon, 2002).

Causality in the model is tested with an error correction model shown at the bottom of the table: the DTD in the current year adjusts to reduce the gap between the actual DTD and its predicted level in the previous year. All of the error correction terms are large coefficients (rapid adjustment within the year) and are significant at the 1% level.

The results may be summed up as follows:

- The Basel Tier 1 ratio appears to find no support as a determinant of the DTD. The simple leverage ratio case is the preferred model, shown in the first column of the first data panel.[4] LEV is well determined at the 1% level, for all banks, for the GSIFI banks and for the other large bank panels. A cut in leverage from say 50 (not un-typical of a GSIFI bank) to the OECD preferred maximum of 20 would raise the DTD by 1.2 standard deviations.
- The macro control variables in house prices and the market BETA are correctly signed and significant at the 1% level, across all models.
- In terms or arguments relating to the business model, the GMV of derivatives and wholesale funding have the expected negative signs and are significant at the 1% level for the full sample and for the GSIFI group. GSIFI banks with derivatives exposure of over 40% of their balance sheet (e.g. banks that engage in prime broking, etc.) are quite common and are of fundamental systemic significance. The OECD recommends separating those banks that undertake prime broking, market making, underwriting and origination once they exceed a GMV derivatives threshold of 10% of the balance sheet. A reduction from 40% to 10% would raise the DTD by 1 standard deviation using the full sample model and by 1.4 standard deviations using the GSIFI model.
- Wholesale funding is negatively linked to the DTD: a 20 percentage point cut would raise the DTD by 0.5 standard deviations.
- Trading assets have the expected positive sign that find support at the 5% level for the full sample and the GSIFI banks, but not in a sample of traditional banks that excludes the GSIFIs. A 20 percentage point rise would raise the DTD by 0.9 standard deviations.

III.2. DTD model results and policy implications

The potential role for monetary policy and perhaps also for macro-prudential policy is supported by the data in this study, given the strong panel regression results for the influence of house prices and BETA. An unexpected fall in house prices of 10%, for example, is estimated to reduce the DTD by 1.6 standard deviations (a bad thing). Asset price mechanisms of that order of magnitude can push a vulnerable bank with a low DTD past the zero point. The results here are consistent with the literature relating to macro policies to lean against cycles in asset prices, were there to be no impediments to such policies via cycle identification and model calibration issues.

Table 2 shows correlations of variables identified by the model as having high systemic significance for bank safety, and three monetary policy variables: the change in US short-term interest rates; the change in US long-term interest rates; and the percentage change in the dollar value of the sum of central bank liabilities of the US Fed, the Bank of England, and the ECB.

The use of the last three macro and monetary policy variables assumes: a key role for USD Libor globally; the high correlation of all bond markets with US bonds; and the fungibility of the use of central banks cash between large financial institutions. The change in the Tier 1 ratio is also included, on the grounds that while its level has no direct

Table 2. **Correlations of model-identified variables and monetary policy variables**

	LEV	%T1	TD	WFD	GMV	%HPI	Diff_10Y GB USA	Diff_3M LIBOR USD	%CB_TA
LEV	1								
%T1	-0.06	1							
	0.08								
TD	0.54	0.02	1						
	0.00	*0.62*							
WFD	0.30	-0.02	0.27	1					
	0.00	*0.53*	*0.00*						
GMV	0.53	0.11	0.67	0.21	1				
	0.00	*0.00*	*0.00*	*0.00*					
%HPI	0.06	-0.16	0.04	0.09	-0.04	1			
	0.06	*0.00*	*0.24*	*0.01*	*0.31*				
Diff_10Y GB USA	0.01	-0.15	0.06	0.05	-0.07	0.54	1		
	0.73	*0.00*	*0.08*	*0.16*	*0.06*	*0.00*			
Diff_3M LIBOR USD	0.09	-0.28	0.03	0.03	-0.02	0.55	0.38	1	
	0.01	*0.00*	*0.30*	*0.30*	*0.66*	*0.00*	*0.00*		
%CB_TA	0.09	0.04	-0.02	0.01	0.08	-0.26	-0.56	-0.13	1
	0.01	*0.28*	*0.45*	*0.71*	*0.03*	*0.00*	*0.00*	*0.00*	

Notes: P-values are shown in italics under the correlation coefficients. A p-value at less than 0.01 implies significance at the 1% level; less than 0.05 at the 5% level; and less than 0.1 at the 10% level.

relevance for the DTD, as noted in the above results, its change directly influences the amount of capital held and might have a role as a counter-cyclical buffer affecting the asset price and leverage cycle. This was the key variable for macro-prudential policy selected in the Geneva Report. P-values are shown under the correlation coefficient. The main features of the correlations are:

- The three monetary policy variables are most highly correlated with the per cent change in the national house price indexes. While no causality is implied, it is clear that rising house prices are associated with rising interest rates, and tightening central bank liabilities, and vice versa. This is consistent with a leaning-against-the-wind monetary policy taking into account the key housing asset price cycle.
- The change in the Tier 1 ratio appears to be negatively related to the house price index variable, (an increase in Tier 1 is associated with a weaker asset price cycle) which suggests it, too, has not been inconsistent with a leaning-against-the-wind additional influence on the house price cycle.
- However, the change in the Tier 1 ratio is also highly significantly correlated with the GMV of derivatives in a perverse way. That is, a tightening up of the T1 ratio is associated with the increased use of derivatives in off-balance sheet products, CVA desk arbitrage, and other forms of regulatory arbitrage that banks use to reduce capital charges and increase their ROEs. The GMV of derivatives variable has one of the biggest independent influences on the DTD. In short, the T1 variable may be associated with helping to improve the DTD in the asset cycle arguments of the model, but it is also associated with other activities that are damaging to systemic stability.
- All three business model influences on the DTD (the GMV of derivatives, wholesale funding, and trading securities) are correlated with each other, and to leverage, but they are not correlated with monetary policy, and they are perversely correlated to the Tier 1

ratio. This block of influences on the DTD must be treated separately from macro-prudential considerations.

- The above results for the DTD of traditional banks (excluding GSIFIs), on the right hand side of Table 1, show that the business model features related to securities markets play no role at all. Leverage, size and the two macro-prudential influences are the main drivers of the DTD for traditional banks. But while countercyclical rules may be effective in this traditional bank segment of the market, those same policies will interact with the GSIFI bank group, where destabilising factors can come into play.
- The OECD has long recommended separating off securities businesses that engage in activities such as prime broking, market making, underwriting and origination. This would pave the way for more effective macro-prudential policy for core deposit banking.

The above results suggest that there is huge complexity and interdependence in the financial system, and hence the calibration of macro-prudential policy may be more difficult than simple counter-cyclical rules based on a clearly defined reference vehicle (e.g. a focus on an asset price or a credit variable). In essence, dealing with a problem in one area may push imbalances into other areas.

IV. EMEs' capital controls as macro-prudential policy

IV.1. Some stylised facts from major EMEs

The ability to use fiscal policy is limited since the global crisis, and the protracted period of monetary ease in advanced economies, which has lasted much longer than many would have expected, may result in a medium-term stock problem with unintended consequences. As this can have unwelcome effects in other countries in the form of spill-overs, the argument is often made that countries need to internalise these spill-overs in their own macro-prudential policy making. Turner (2012) is cautious about this and, focusing on the experience of India, cites the difficulties of reading the global financial environment and its spill-overs to EMEs. He also notes the special problems of EMEs in separating too rapid credit growth from the need to build credit intermediation and deeper capital markets over the longer term, which are needed to fund infrastructure projects in the economy and reduce constraints on growth. Policy makers could be either too cautious, underestimating structural change, or wait too long to tighten credit in the belief that structural financial deepening is taking place. The 2009/10 BIS Annual Report stated a position with which the authors here strongly agree; that: "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" (BIS, 2010, p. 56).

Many emerging market economies (EMEs) use capital controls to manage the capital account when they perceive they are in disequilibrium. The motivations for using these tools can be divided into two broad categories: *a)* exchange rate management; and *b)* macro-prudential concerns.

Impossible trinity motivation for controls: One motivation for capital controls relates to the so-called "impossible trinity": that it is not possible to maintain an open capital account, manage the exchange rate, and maintain independent monetary policy. Intervention to prevent the currency rising in the face of strong capital inflows, without controls on such flows, results in domestic money and credit creation which can be excessive. Conversely, outflows lead to monetary contraction if reserves are used to defend the currency and/or to

avoid mismatches and dollar funding illiquidity. Controls on capital inflows and outflows help to reduce this tri-lemma when exchange rate management is the key goal: tighter controls result in less intervention for a given degree of exchange rate management. Controls of this nature are directed at the overall market and affect the ability of domestic and foreign agents to move capital between currencies.

Macro-prudential motivation for controls: A second motivation is that countries can have concerns about the impact of short-run capital flows on the safety of the banking system, particularly where foreign currency funding is important. Such funding may be perceived as unstable in nature, and may expose the banking system to liquidity problems in the event of financial crises and any sudden withdrawal of funds. If such measures take the form of direct constraints on a market where cross-border transaction between currencies takes place, they will be observationally equivalent to the exchange rate management motivation. Examples of direct measures in this category include inter alia:

- Quantitative caps on foreign currency borrowing, and foreign exchange (FX) swap, options and forward positions.
- Limiting foreign exchange transactions to those supporting underlying trade and investment activities.
- Imposing limits on amounts of and minimum holding periods for government securities.
- Variation in taxes and other direct levies on cross-border flows.

If the measure taken is not directed at the international capital market, but instead is applied to banks in a manner consistent with accepted internationally agreed prudential arrangements, then such a measure would not affect capital flows and covered interest parity (CIP) directly, and would fall more within micro-prudential measures or macro-prudential policy in the sense of variations in capital buffers discussed in Section II. For example, the Basel capital rules could be used in this way: banks running up riskier balance sheets due to foreign funding might be asked to hold more capital. Bank models should reflect such risk in the Basel risk weights, and bank supervisors could ensure that this is the case. Countercyclical capital buffers using the Tier 1 ratio might also be used. Similarly, the Liquidity Coverage Ratio and the Net Stable Funding Ratio might also be used in a way to reflect concerns about unstable foreign funding of banks. These sorts of measures would not affect capital flows directly, and are not the concern of the macro-prudential measures analysed in this section.

Carmichael (2012) points out that the direct capital controls work best when they support macroeconomic policies, and particularly if they work through affecting relative prices. This may be right at certain times, but whether it helps to achieve greater macro stability overall is an empirical question. If the macro-prudential policies aimed directly at the capital account help policy makers to resolve the impossible trinity issues and keep banks safer, then this should be reflected in a better GDP outcome, regardless of whether the country is being subject to inflow or outflow pressures. Covered interest parity (CIP) is a useful empirical tool that can quantitatively measure the influence of capital controls on relative FX prices during periods of pressure from net capital flows in either direction.

CIP is widely accepted as a measure of the degree of openness of economies. There is an extensive literature on this subject, where deviations from CIP are seen as a reflection of capital controls, political risk and (elevated) transactions costs that lead to market segmentation.[5] CIP compares the yields on assets with the same duration issued in different countries and denominated in different currencies but hedged to eliminate

currency risk. In the absence of capital controls, the yield on the foreign asset hedged in the forward market should be in line with the domestic rate, except for (small) transactions costs. The covered interest parity condition from the viewpoint of a dollar investor is:

$$f/s - (1 + r)/(1 + r^*) = 0, \quad [1]$$

where f is the forward rate, s the spot rate (US dollars per unit of foreign currency), r the US dollar rate and r^* is the foreign rate.[6]

Capital controls lead to market innovations in the attempt to avoid them: to facilitate speculation and hedging where this is otherwise restricted. Of interest here is the development of a non-deliverable forward (NDF) market, which occurs only when onshore forward markets have restricted access. These NDF markets are located offshore and are structured contractually to allow net settlement in US dollars. All offshore investors participate in the NDF market, and often onshore domestic banks can participate in NDF trades (though with restrictions), which is important in the arbitrage process.[7] The very existence of an NDF market normally indicates the presence of strong capital controls. The tighter are the restrictions on the domestic forward market, the larger should be the deviations between the two markets and the longer it may take to arbitrage between the NDF, spot and domestic forward markets. Where there are no meaningful cross-border capital-flow restrictions NDF markets normally do not develop.

Figure 1 shows the onshore forward and the NDF market CIP deviations (from the zero condition in equation [1]) for Korea, China and India, from the viewpoint of the dollar-based investor. Smaller deviations in CIP are an indication of greater openness, and vice versa.

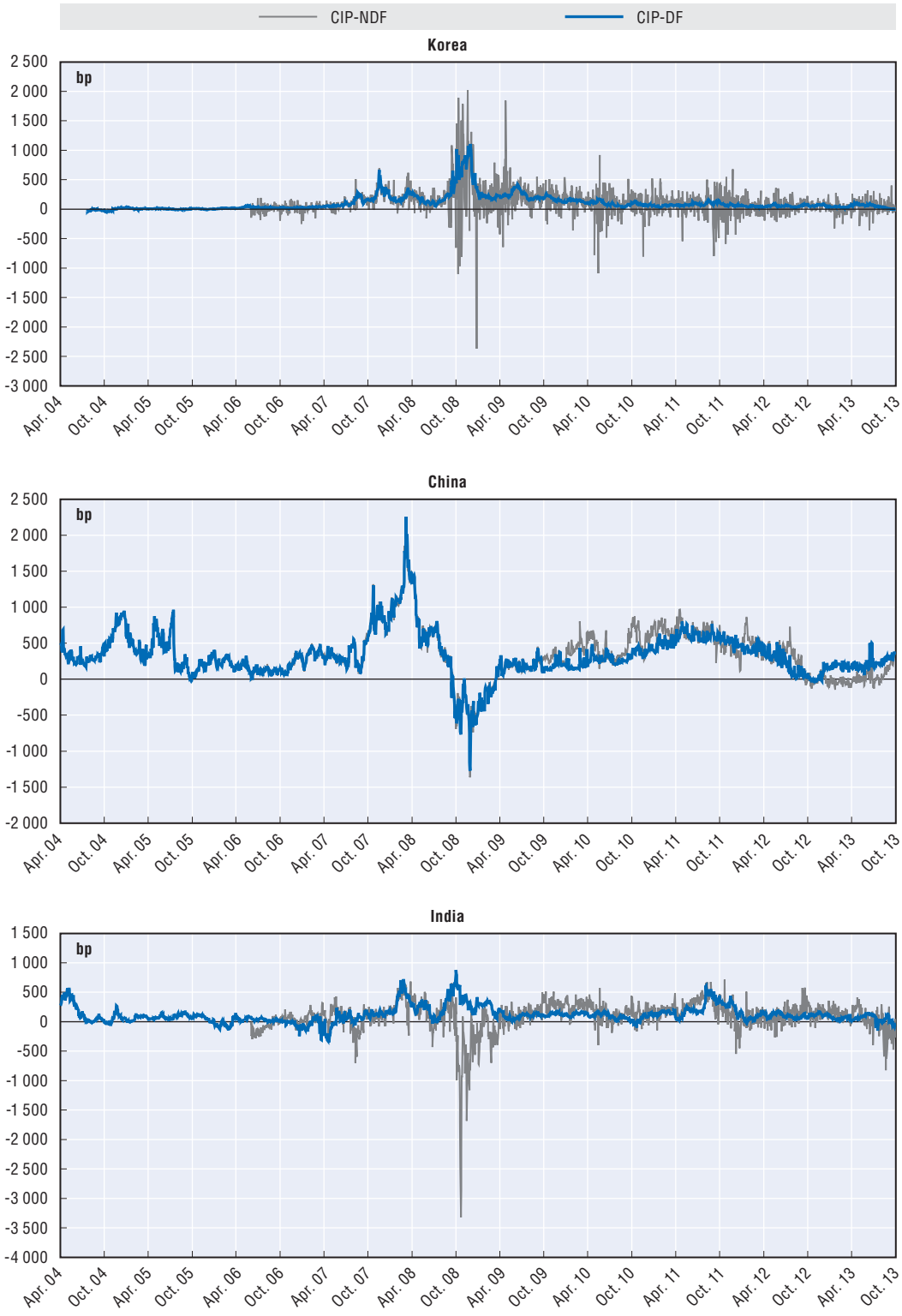
Figure 2 compares CIPs for the Korean NDF market and the forward markets in three emerging economies where restrictions are not as important, so that offshore NDF markets have not developed: Mexico, Turkey and South Africa. The deviations from CIP in countries with the most restrictions can be extreme. However, the evidence of success with these policies is not apparent.

In the case of India, inflow and outflow controls are in place, and the effects of the latter are most apparent during crisis times, as in the late 1990s/early 2000s; the 2008-09 period; and again very recently in mid-2013. India has used capital controls and countercyclical capital rules for some years, while it has pursued a policy of easy monetary policy. The macro imbalances that appear to have developed in 2013 suggest that their set of macro-prudential tools involving capital controls may not be sufficiently powerful to reconcile competing objectives.[8]

Similar deviations from CIP are present in China, though there the intensity of controls has been greater on the capital inflow side. China has better managed to run tighter domestic monetary policy in recent years via domestic financial repression combined with capital controls, hence reducing or delaying the sorts of pressures that have built up in India. The PBOC raised reserve requirements 12 times in 2010-11 (to 21.5%) to rein it in the strong credit growth that it promoted during the global crisis. Reserve requirements on deposits are a tax on banks, while interest rate ceilings in place put a limit on banks' ability to attract deposits when inflation rises. Capital controls limit foreign funding. Banks attempt to avoid these restraints by using off-balance-sheet vehicles, such as wealth management products (WMPs) and trust company investments and lending. Trust company lending in China has been rising since 2011, and this net flow measure has been running at over 100% p.a. in 2012-13. WMP funding is short-term via bonds and repos with

Figure 1. **Korea, China, India: CIP deviations on DF vs NDF markets**

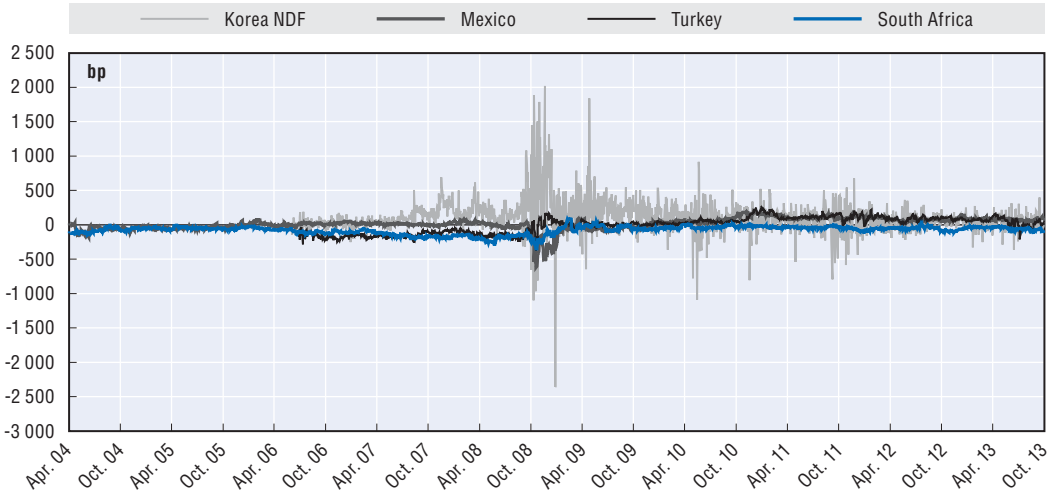
Deviations from covered interest parity (CIP) on domestic forward (DF) and non-deliverable forward (NDF) markets, in basis points



Source: Datastream, authors' calculations.

Figure 2. **CIP deviations: Korean NDF vs DF markets of Mexico, South Africa, Turkey**

Deviations from covered interest parity (CIP) on domestic forward (DF) and non-deliverable forward (NDF) markets, in basis points



Source: Datastream, authors' calculations.

(controlling) banks, and they invest in money market funds (MMFs), lend to over-capacity SOEs and to local governments, and real estate loans play a large role as well. "Entrusted loans" are also used (essentially companies lending to each other with a bank-linked off-balance sheet entity in between). In short, financial innovation is finding ways to get around the financial repression.

Korea has battled both inflows and outflows. Both before the crisis and after it inflows have created unwanted upward volatility of the exchange rate. The authorities have focused on a number of tools to restrict foreign currency borrowing and, since 2010, have imposed quantitative caps on the ability of onshore banks and foreign bank branches to participate in general FX derivative markets. These have been tightened twice since. During the crisis the reverse problem came into play, as lenders withdrew funding from Korea, creating currency mismatches and funding difficulties.

All three countries manage the exchange rate against the US dollar, and capital controls support this approach to policy. The proponents of the use of capital controls for macro-prudential policy argue that they help these countries to achieve broad stability objectives, such as avoiding excessive foreign currency mismatches, and excessive credit creation and asset cycles more generally. The IMF has been at the forefront of international organisations supporting these measures for EMEs.

IV.2. Empirical evidence

How successful such controls are in helping to reconcile conflicts in macro objectives is largely an empirical issue. The ultimate test of the success of capital controls as a macro-prudential tool is whether over time they lead to a better GDP outcome: that the inflow periods do not destabilise asset prices and credit growth to the point of causing macro imbalances; and that the outflow periods do not lead to financial collapse. The IMF study by Ostry et al. (2010) for 37 EMEs used a probit regression approach to show that capital controls on inflows appeared to help EMEs to avoid output loss in the global crisis. This

study was claimed by the authors to provide some indicative correlations only, but it has nevertheless been quoted extensively by supporters of capital flow measures. These results were reproduced exactly by Blundell-Wignall and Roulet (2013) and then tested for robustness. The IMF results were found not to be robust to stability checks, leading to the conclusion that they are not a sound basis on which to make strong claims about the success of capital controls.[9]

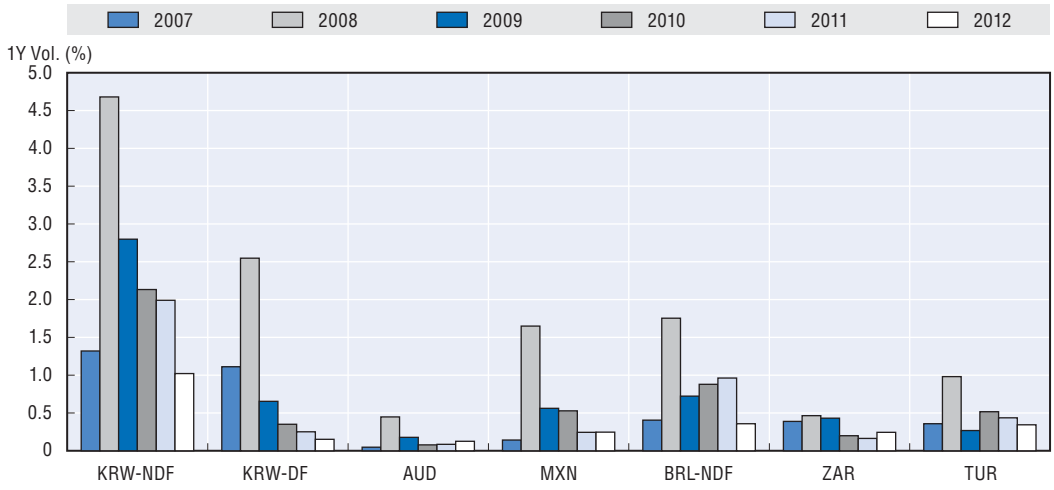
A general and intuitively more obvious way to test for the success of macro-prudential capital controls is to carry out a panel regression study using actual data rather than dummy variables. Such an investigation was carried out for exactly the same panel of 37 countries with actual GDP growth as the dependent variable. The same IMF capital control measures as the ones in the Ostry et al. (2010) study were used.[10] The results showed that there was no support for a positive impact of overall controls on inflows for GDP over the full sample: beneficial effects were found for the pre-crisis period, and negative ones for the crisis period. The results were seen as being consistent with exchange rate management issues, i.e. helping to resolve the "impossible trinity" issue in the "good" period inflow years, while at the same time benefitting trade via a lower exchange rate than would otherwise prevail. In the outflow years, when the opposite pressures are in play and the exchange rate is very weak, countries that have controls experience significantly worse GDP outcomes via capital flight that is more pronounced than for open economies.

The IMF capital control measures are annual and in a binary form, taking values of 0 (unrestricted) and 1 (restricted) for six categories of inflows, and an overall indicator is obtained by averaging these measures. The IMF binary measures do not distinguish between the extensiveness and intensity of different controls in the various countries. Deviation from CIP on the other hand is a direct measure of the interaction between the presence of controls, political risk and the intensity of the flows a country faces: strong controls and large flow pressure result in large deviations and vice versa. The presence of large volatility in CIP deviations suggests dislocations in markets related to the controls which are disruptive to financial flows and the fair value pricing of assets and liabilities, and are therefore potentially damaging to economic performance that is the objective of macro-prudential policy. In order to take account of these influences, the following measures of capital controls are included in the following new analysis on their effectiveness in EMEs:

- The IMF average indicator of controls on overall capital inflows based on the Schindler (2009) index, which is updated to 2011 using the IMF methodology.
- The one-year volatility (in standard deviations) of CIP deviations for 29 emerging countries included in the study, based on daily data (annual average volatility with no overlapping observations between years), is calculated.[11] For countries where NDF markets are present, the NDF measure of CIP deviations is used, as opposed to the restricted domestic forward market.[12] The CIP deviation measure captures both inflow and outflow pressures, unlike the IMF index used by Ostry et al. (2010) that applies to inflows only. Capital controls and political risk collide with net inflow or outflow pressure to create volatility that reflects segmentation of markets and disruption to prices and flows.

Figure 3 shows the one-year volatility of the CIP deviation measure for a number of emerging countries (Mexico, Turkey, Brazil, South Africa, and Korea) before, during and after the crisis. In this group only Korea and Brazil have NDF markets. The Australia dollar

Figure 3. **One-year volatility of CIP deviations, selected countries**



Source: Datastream, authors' calculations.

CIP deviation volatility is also included as a point of reference for a country that does not use capital controls – and the measure there is typical of other advanced country currencies, such as the euro and the yen. Volatility rose during the crisis, and most strongly in Korea, where restrictiveness in the domestic market had long led to the operation of an NDF market. While volatility has subsequently moved down in 2013, and picked up in Brazil and Turkey, the Korean volatility of CIP remains the highest in this group.

The dependent variable for the study is annual real GDP growth of EMEs (N_GDP) over the period 2003-11 (including the years before and after the global crisis). The explanatory variables include:

- The two above indicators of capital controls: the one-year volatility of CIP deviations (VOL_CIP); and the IMF measure (O_I). The expected signs are ambiguous, depending on whether capital controls are helpful or harmful to economic growth.
- Annual real world GDP growth (W_GDP) is included as a macro control variable to take into account any benefits in terms of national growth that emerging economies may have from global growth according to their degree of trade openness. The expected sign for the coefficient of this variable is positive.
- Real oil prices (LN_OIL_CPI)[13] are used to control for the impact of energy prices on the terms-of-trade, which affect real transfers between net importers and exporters of oil. The expected sign for the coefficient of this variable is ambiguous.

Table 3 presents the descriptive statistics of the data used in the regressions for the different sample time periods around the global financial crisis.

Lagged real GDP growth is included to control for persistence of other own-country GDP influences – the approach is testing for the effects of the two sets of capital control measures in addition to the information included in the countries' recent past GDP history. Since annual world real GDP growth is in part endogenous to national real GDP growth,[14] this explanatory variable has been instrumented.[15] All macroeconomic data are extracted from the IMF's *World Economic Outlook Database*. The exchange and interest rates data were taken from Bloomberg and Datastream.

Table 3. **Some characteristics of the data**

	N_GDP	VOL_CIP	O_I	W_GDP	LN_OIL_CPI
			2003-09		
Mean	**4.59**	**1.32**	**0.43**	**3.45**	**1.70**
Median	5.28	0.73	0.42	4.58	1.05
Max.	*14.16*	*8.90*	*1.00*	*5.44*	*9.04*
Min.	*-17.73*	*0.03*	*0.00*	*-0.59*	*-1.86*
Std. Dev.	***4.53***	***1.64***	***0.37***	***2.27***	***2.18***
			2003-07		
Mean	**6.54**	**0.84**	**0.41**	**5.00**	**1.69**
Median	6.33	0.53	0.25	5.27	1.06
Max.	*14.16*	*3.54*	*1.00*	*5.44*	*9.04*
Min.	*0.13*	*0.03*	*0.00*	*3.69*	*-1.20*
Std. Dev.	***2.56***	***0.84***	***0.39***	***0.53***	***2.09***
			2008-09		
Mean	**1.45**	**2.09**	**0.48**	**0.97**	**1.70**
Median	2.68	1.30	0.50	-0.59	0.95
Max.	*9.80*	*8.90*	*1.00*	*2.81*	*8.72*
Min.	*-17.73*	*0.13*	*0.00*	*-0.59*	*-1.86*
Std. Dev.	***5.21***	***2.24***	***0.34***	***1.71***	***2.35***
			2003-11		
Mean	**4.63**	**1.34**	**0.46**	**3.78**	**1.87**
Median	5.15	0.77	0.50	4.58	1.12
Max.	*14.16*	*9.74*	*1.00*	*5.44*	*9.04*
Min.	*-17.73*	*0.03*	*0.00*	*-0.59*	*-1.86*
Std. Dev.	***4.16***	***1.71***	***0.36***	***2.00***	***2.26***
			2008-11		
Mean	**3.17**	**1.72**	**0.50**	**2.86**	**2.00**
Median	3.69	1.09	0.50	3.95	1.16
Max.	*11.23*	*9.74*	*1.00*	*5.22*	*8.91*
Min.	*-17.73*	*0.11*	*0.00*	*-0.59*	*-1.86*
Std. Dev.	***4.54***	***2.07***	***0.34***	***2.20***	***2.38***

Note: Descriptive statistics for a sample of 29 emerging economies. N_GDP, W_GDP and VOL_CIP are expressed in per cent.
Source: International Monetary Fund, Bloomberg, Datastream, authors' calculations.

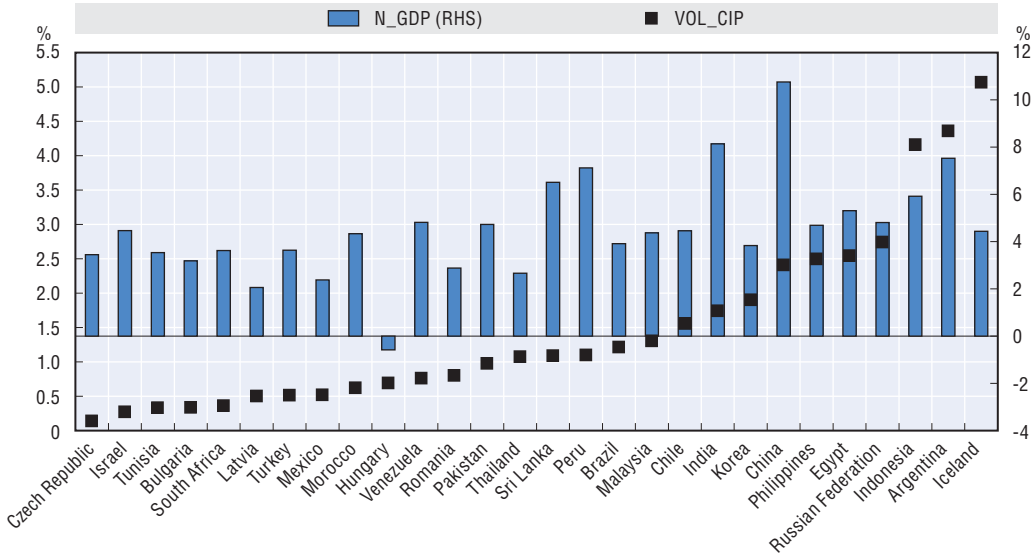
Figure 4 shows the ranking of all countries in the sample by the average level of one-year volatility of CIP deviations alongside the average annual real GDP growth rates over the period 2003-11, shown with columns.

This model is estimated by the Generalised Method of Moments (GMM) using first differences (Arellano and Bond, 1991). This estimation is robust to heteroskedasticity and autocorrelation. The correlations between the exogenous variables are appropriately weak.

Table 4 shows the regression results for the different sample time periods around the global financial crisis. The main features of the results are as follows:

- The macro control variable, world GDP, is strongly supported by the data, with coefficients greater than 1.0 as the countries in the sample grow faster than the rest of the world. Lagged national GDP growth is also important (other than for the too short 2008-09 period), indicating persistence effects. The oil price has a mostly significant negative effect.

Figure 4. **Annual real GDP growth rate and one-year volatility of covered interest parity deviations**



Sources: IMF, *World Economic Outlook*, Bloomberg, Datastream and authors' calculations. All figures are averaged over the period 2003-2011 and expressed in per cent.

Table 4. **Econometric results: Capital controls and economic growth**

	Whole period		Pre-crisis period	Crisis period	
	2003/2009	2003/2011	2003/2007	2008/2009	2008/2011
VOL_CIP	-0.30***	-0.16***	-0.15***	-0.37 **	-0.11 **
	(-21.40)	(-8.78)	(-2.58)	(-2.09)	(-1.96)
O_I	-0.02***	-0.002	0.02 **	-0.03***	-0.01***
	(-4.80)	(-0.54)	(2.24)	(-6.39)	(-4.34)
N_GDP(-1)	0.19***	0.26***	0.05***	0.23	0.18***
	(15.33)	(18.91)	(2.69)	(1.36)	(7.83)
W_GDP	1.21***	1.21***	1.15***	1.11***	1.19***
	(75.30)	(58.80)	(8.40)	(10.79)	(50.35)
LN_OIL_CPI	-0.02***	-0.01***	-0.02	-0.02***	-0.01***
	(-10.17)	(-15.69)	(0.70)	(-5.33)	(-19.90)
J-statistic	21.58	22.19	15.73	16.01	22.60
Prob(J-statistic)	0.49	0.51	0.33	0.31	0.42
Observations	109	164	59	46	100

Note: This table shows the results of estimating a dynamic panel model with the GMM estimator proposed by Arellano and Bond (1991) for a sample of 29 emerging economies. The dependent variable is annual real GDP growth rate. See Section III.2 for the definition of all the explanatory variables. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels, respectively. Standard errors are corrected for heteroskedasticity following White's methodology.

- For the different sample time periods around the global financial crisis there is strong evidence supporting the notion that controls on overall capital flows and political risk as measured by the one-year volatility of CIP deviations harm prospects for emerging market growth over the full period, the pre-crisis period and the crisis period. The coefficients of this variable are negative and significant at the 1% or 5% levels. A rise in the standard deviation of annual CIP deviation volatility by 5 percentage points, using the long sample coefficient of 0.16, would normally be associated with 0.8% less GDP growth.

- The results obtained for the controls on overall capital inflows as measured by the IMF are mostly consistent with those previously obtained in Blundell-Wignall and Roulet (2013). The new results are even more clear-cut: for the full IMF sample period 2003-09, the previous finding of insignificance is replaced in the new model with an unambiguous negative influence of O_I, now supported at the 1% level. As before, the coefficient of the IMF indicator is significant and positive at the 10% level in the 2003-07 pre-crisis sample period. A negative coefficient supported at the 1% level is found for the IMF measure for both of the crisis periods considered (2008-09, and 2008-11).

Most emerging countries focus on exchange rate targeting and use some form of capital controls to support this approach to help resolve the "impossible trinity" trade-offs. Whatever benefits these countries believe they obtain from these measures when used as a macro-prudential tool, the results here show that this is certainly not reflected in better GDP growth outcomes – taken here as an overall test of the success of such policies. Indeed, the deviations in CIP that result from such policies, caused by segmentation and dislocation in financial flows and prices, is negatively correlated with GDP growth in all of the sample periods.

When the CIP deviation volatility measure is included, the previous finding that controls on inflows as measured by the IMF have positive effects in the pre-crisis years and negative effects during crises is again reproduced. In the pre-crisis period, when inflows are strong and the risk of exchange rate appreciation is high, imposing controls on inflows reduces that pressure, giving rise to trade benefits, and at a time when cash flows are strong in the domestic corporate sector. This is a win-win situation where restraint on foreign funding of the banking system is less problematic for domestic firms and there is a complementary need to reduce money and credit expansion that results from foreign reserves accumulation. However, in a crisis, funding constraints are more binding on firms as cash flows decline while the reversal of capital inflows puts downward pressure on the exchange rate. Controls on capital inflows at these times are more problematic for firms, with negative implications for GDP growth. Cash flow is weak, credit conditions tighten (with foreign exchange reserves loss and tighter monetary conditions), and hence the need for bank funding and FDI flows from abroad rises. At these times high capital control countries are not a desirable destination for foreign investors. It is likely that those countries with high political risk in respect to quantitative measures on the capital account are precisely those that are hardest hit in a crisis.

V. Conclusions

This paper has focused on the complexity of macro-prudential issues in the face of bank systemic risk in advanced countries and the use of capital controls as a macro-prudential tool in EMEs. The influences on bank systemic risk from multiple sources (the asset cycle, the business models of banks, leverage and time varying capital rules) are complex and interdependent. Similarly, the evidence about capital rules for EMEs suggests that they do lead to better GDP outcomes overall. This suggests that much care should be taken in implementing macro-prudential policy, and precise policy assignments must be put aside until more work is done to better understand all the interactions:

- Changes in the Tier 1 capital ratio appear to be associated negatively with the housing price cycle, which is appropriate for macro-prudential policy in this sector. But such changes in T1 are also clearly associated the wrong way with derivatives activity, which play a role in securitisation, regulatory arbitrage and the creation of new synthetic products.

- Variations in the T1 ratio are negatively correlated with monetary policy. This is a concern, because it likely reflects macro-prudential policy being thought of as a partial substitute for monetary policy. The risk here is that policymakers might believe they can avoid taking difficult monetary policy decisions.
- Derivatives and wholesale funding (negative influences on bank's DTD) and liquid trading securities (a positive influence), merit consideration for policy treatment, given the power of the above DTD model results. These activities are correlated with each other, and related to business model issues. They are not correlated with monetary policy, and systemic risks from this source cannot be treated with macro-prudential policy. A successful macro-prudential policy for core deposit banking functions would be enhanced by separating these activities from securities businesses. If this is not done, the macro-prudential policy measures may set off interactions that are in conflict with each other so that the net benefits are ambiguous.
- The OECD recommends such separation via a non-operating holding company structure, once a banks' holdings of derivatives (GMV) rises above 10% of the IFRS balance sheet – that is, the bank is moving into prime broking, market making underwritings and origination in these areas – well beyond anything required to hedge their own portfolios. The OECD proposal is focused on getting the risks priced properly within the private sector by explicitly eliminating too-big-to-fail (TBTF) cross-subsidisation of risk taking in universal banks. Ring-fencing the core deposit-taking bank, and having all the other non-bank subsidiaries not supported by a lender-of-last-resort, fully resolvable, and with creditors that cannot chase the assets of other members of the group, would ensure appropriate margin and custody policies automatically without civil servants prescribing what they should be (as implied by some of the tools noted above). This would perhaps pave the way for non-destabilising macro-prudential policy for the core deposit taking sector of the banking system.
- Capital controls do not appear to be an appropriate macro-prudential tool for EMEs, and certainly the IMF findings in this regard are not a robust basis to make such claims. Segmentation and disruption of flows and prices as reflected in deviations from CIP are associated with weaker GDP outcomes. The apparent effectiveness of controls on inflows in non-crisis years appears to stem from the fact that these policies support exchange rate targeting macro strategies (always at the expense of other countries). Capital controls on inflows have a positive effect on GDP, because of trade benefits via competitiveness while permitting less conflict with domestic monetary creation that follows from foreign exchange market intervention. However, when risk aversion rises, economic growth slows down and net outflows begin to dominate cross-border capital movements, the evidence suggests that the presence of controls on flows is very damaging. Taking good years and crisis years together, the results from the sample period considered here suggests a negative net outcome for GDP growth.

There is a temptation to believe that reverting to macro-prudential policies with a sector focus, so prevalent in the 1960s, 1970s and early 1980s, will help resolve issues that arose out of the financial crisis in both advanced and emerging countries. However, the world has become much more complex and more interdependent. This paper cautions that stepping back in time with a sector approach to monetary policy may risk countries not getting the right fiscal and monetary policy balance, the requisite need for exchange rate flexibility and the much needed structural reforms.

Notes

1. See Clement (2010).
2. See Appendix 1, Blundell-Wignall and Roulet (2012).
3. This is short-term (including repo) and some longer-term debt securities that need to be rolled – it excludes deposits, equity, subordinated debt and derivatives liabilities from total liabilities.
4. The T1 variable is not significant in any of the sub models, and these are not shown for simplicity.
5. See Frenkel and Levitch (1975), Peel and Taylor (2002), Obstfeld and Taylor (2004) and, more recently, Blundell-Wignall, Atkinson and Roulet (2013).
6. Three-month interbank rates are used in the calculations.
7. Arbitrage requires some access of traders to both the NDF and the domestic (restricted) forward market.
8. Sinha (2012), however, argues that the RBI policies have been highly successful from 2004 to 2011.
9. See Blundell-Wignall and Roulet (2013). The IMF study looked at the output growth loss after the crisis compared to before it, and created deciles ranging from better to worst GDP loss. The dependent variable takes on a dummy value of 1.0 for those in the worst GDP decile and 0 elsewhere. The capital control measures are also based on the binary form of 1.0 (for a control) or 0 (for no controls). The regressions show that the capital control measures influence the probability of being in the worst decile. Latvia, Turkey, Iceland and Kazakhstan find themselves in the worst GDP decile in the crisis, and are associated with fewer capital controls. Latvia had a 20% fall in cumulative output in the crisis period, the next worst being Turkey with a relatively much smaller 9% contraction in output. If Latvia is excluded and replaced in the bottom decile by the next worst case (Russia), nothing in the regressions is significant. This means that the results cannot be taken as meaningful.
10. See Blundell-Wignall and Roulet (2013). The IMF measure is based on the Schindler (2009) index of controls.
11. The sample in Blundell-Wignall and Roulet (2013) was 37 emerging economies. However due to data limitation, the following 29 countries are included in the final sample: Argentina, Brazil, Bulgaria, Chile, China, Czech Republic, Egypt, Hungary, Iceland, India, Indonesia, Israel, Kazakhstan, Korea, Latvia, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Romania, Russia, South Africa, Sri Lanka, Thailand, Tunisia, Turkey and Venezuela. The following 8 countries are excluded from the sample: Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Jamaica, Lebanon and Uruguay.
12. The following 13 countries have an NDF market: Argentina, Brazil, Chile, China, Egypt, India, Indonesia, Kazakhstan, Korea, Malaysia, Peru, Philippines and Russia. Restrictions on the onshore market force underlying volatility onto the NDF market.
13. It is the logarithm of the ratio of oil price to CPI, both denominated in national currencies.
14. There is two-way causation between national GDP growth and world GDP growth, particularly where big countries like China are included.
15. After testing for weak instruments, the two-year lagged value of the annual real world GDP growth rate is introduced in the regressions.

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