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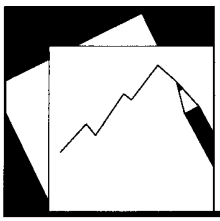

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Macro-Prudential Policies to Mitigate Financial System Vulnerabilities

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Abstract

Macro-prudential policies aimed at mitigating systemic financial risks have become part of the policy toolkit in many emerging markets and some advanced countries. Their effectiveness and efficacy are not well-known, however. Using panel data regressions, we analyze how changes in balance sheets of some 2,800 banks in 48 countries over 2000–2010 respond to specific macro-prudential policies. Controlling for endogeneity, we find that measures aimed at borrowers—caps on debt-to-income and loan-to-value ratios—and at financial institutions—limits on credit growth and foreign currency lending—are effective in reducing asset growth. Countercyclical buffers are little effective through the cycle, and some measures are even counterproductive during downswings, serving to aggravate declines, consistent with the ex-ante nature of macro-prudential tools.

JEL Classification Numbers: E43, E58, G18, G28

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I. INTRODUCTION

This paper analyzes the use of macro-prudential policies aimed at reducing vulnerabilities in banking systems. Recent events have highlighted the high costs of financial crises. More generally, the potential economic costs arising from the way financial systems operate – whether from excessive financial cycles or spillovers through interconnectedness – are increasingly recognized. Due also to policy and research efforts (e.g., Borio and White, 2003, White, 2006, Brunnermeier et al., 2009), this has led to greater acknowledgement for the potential value of macro-prudential policies (see Bank of England, 2009, Hanson, Kashyap, and Stein, 2011, and De Nicolò et al., 2012 for analytical reviews; see further IMF, 2011; 2012b; 2013a and 2013b). These policies aim to contain (the buildup of) systemic risks and achieve greater financial stability, and in that way reduce any adverse consequences – including through crises – for the real economy. They are meant to complement micro-prudential regulations and traditional macroeconomic management tools, notably monetary and fiscal policies.

While the greater recognition has come from the recent crises in advanced countries, emerging markets have had much greater experiences with macro-prudential policies, in part as they have had more pronounced business and financial cycles. This greater cyclicality is due to their larger exposures to volatile international capital flows, commodity price shocks, and other risks, and external and internal transmission channels that operate more adversely. In this context, there is much to learn for advanced countries from emerging markets, and there are lessons for emerging markets themselves, on the effectiveness of macro-prudential policies. More generally, cross-country analysis can be an input to help assure that macro-prudential policies are properly designed and calibrated to country characteristics and circumstances.

To help guide the use of macro-prudential policies, this paper asks the following three questions. What macro-prudential policies are available in principle and what policies have countries actually used? What is the evidence to date on the effectiveness of these different policies? And what are the specific experiences with policies in terms of reducing banking systems' vulnerability? On the basis of our new analysis as well as the existing literature and other experiences, the paper concludes with thoughts on which macro-prudential policies countries can best use given their situations, and makes suggestions for further research.

We are not the first to study the use and effectiveness of macro-prudential policies (see Claessens et al., 2011 for a collection of papers and Claessens, 2015 for a comprehensive review of studies). Most studies, however, take an aggregate perspective, that is, they investigate the effects of policies at the overall economic or financial sector level – e.g., credit or asset price growth, the occurrence of a financial crisis – or at the subsector level – e.g., real estate credit, house or other asset prices. We extend this work by investigating how policies may affect behavior at the more microeconomic level; specifically we analyze the role of macro-prudential policies in limiting the buildup of vulnerability in individual banks' balance sheets (and thereby in overall banking systems).

Studying banks is useful as they often are major propagators of business and financial cycles. As emphasized by Adrian and Shin (2010, 2014), banks' risk appetite is inherently procyclical. Banks tend to manage the size of their loan book so as to maintain their (risk-weighted) assets as a constant ratio to capital. Since during booms measured risks (specifically "value at risk") tends

to decline, banks are then more likely to expand lending and the size of their assets more generally. In doing so, they can accelerate an ongoing cycle. As asset prices increase further, corporations' and households' collateral values rise, which enables them to borrow (even) more. This further exacerbates the asset price-financial lending spiral and fuels the cycle. In the process though, banks' balance sheets on aggregate become vulnerable to shocks or downturns.

The channels through which banks can become vulnerable are multiple, as shown in Figure 1. As the cycle starts, asset prices rise, and banks increase their lending, they need to attract new funding, either domestically or from abroad. In the process, they tend to increase not only their leverage, but also their reliance on non-core liabilities, often incurring foreign exchange and maturity mismatches (Shin, 2010). Conversely, during downturns, when measured risks rise and asset prices decline, banks contract their balance sheets, and do so with increasing severity as a vicious spiral of declining asset prices and shrinking net worth develops. As such, identifying those macro-prudential policies most effective in reducing this procyclicality in banks' balance sheets can be very important for reducing overall systemic risks.

We analyze the effectiveness of various macro-prudential policies using some 18,000 observations on approximately 2,820 banks over the period 2000-2010, of which approximately 1,650 are in 23 advanced countries and 1,170 in 25 emerging markets. Besides being able to control for more characteristics driving balance sheets behavior, one advantage of using individual bank data is that there is less concern for endogeneity as macroprudential policies are adopted in response to aggregate bank behavior and less likely to individual bank behavior alone. The large sample of countries, including both advanced countries and emerging markets, and relatively open and closed capital account economies, allows us also to explore the role of differences in country circumstances and conditions. Besides differentiating by type of policies, we also distinguish, between the phases of a country's financial cycle, i.e., whether overall credit extended to the private sector is in an upswing or downswing, as we expect policies to operate differently depending on the phase.

We group the macro-prudential policies actually used according to whether they are aimed at borrowers (caps on debt-to-income (DTI) and loan-to-value (LTV) ratios), banks' assets or liabilities (limits on credit growth (CG), foreign currency credit growth (FC) and reserve requirements (RR)), policies that encourage counter-cyclical buffers (counter-cyclical capital (CTC), dynamic provisioning (DP) and profits distribution restrictions (PRD)) and a final group of miscellaneous policies (which have some overlap with the first three groups). We then perform panel, GMM regressions relating these policies to changes in individual banks' assets. We find that policies aimed at borrowers are effective in (indirectly) reducing the buildup of banking system vulnerabilities. Measures aimed at banks' assets and liabilities are very effective, but counter-cyclical buffers as a group show less promise. The category Other is also very effective.

When we distinguish between upswings and downswings in the overall credit cycle in the countries, we report some important findings. The same three set of policies, i.e., all except for the buffer-based category, directly help reduce asset growth during upswings, with policies aimed at banks' asset and liabilities and Other measures again helping the most. While the borrower-based measures help reduce asset growth to a lesser degree, they do stop declines in

bank asset growth in contractionary periods in a statistically significant way. Measures aimed at banks' asset and liabilities side as group and the category Other also have positive impact in contractionary periods, but their significance levels are only 25% and 16% respectively. And measures aimed at building banks' buffers are not productive in downswings (or upswings).

The effectiveness of bank asset and liability-based measures in affecting asset growth should not surprise as they operate directly on banks' balance sheets. The fact that demand-oriented measures largely aimed at the real-estate markets are effective in addressing banking vulnerabilities is relevant for two reasons: one, real estate cycles are important aspect of the overall financial cycles, often triggering major concerns about systemic risks, which makes the effectiveness of these measures important for policy makers; and two, the fact that addressing demand for credit directly can be effective – to reduce banking system vulnerabilities – suggests it could face fewer problems of implementation, including circumventions, as real estate markets are generally closely monitored and regulated already. While we do not find that policies aimed at building up buffers help reduce procyclicality, these effects need not be absent in general. Relatedly, we conjecture that some macro-prudential policies aimed at mitigating the buildup of financial vulnerabilities can work perversely during financial downturns. If macro-prudential policies are not relaxed sufficiently and in a timely manner during such periods, they can exacerbate the downturns. As such, a lesson is that macro-prudential policies need to be properly calibrated and adjusted to be effective measures in limiting declines in bank assets.

While macro-prudential policies can be important elements of the policy toolkit aimed at overall systemic risk mitigation, especially for countries exposed to international shocks, these policies also imply some costs as they affect resource allocations, including possibly limiting (efficient) financial sector development. And poorly designed or wrongly implemented tools can be circumvented, imply further distortions and possibly even work perversely. A general conclusion therefore is that to provide the most benefits, policies need to be properly chosen, carefully calibrated depending on country and financial system characteristics, and adjusted quickly as circumstances change.

The paper itself is structured as follows. Section 2 provides an overview of the various macro-prudential policies available in principle. It then reviews the actual use of policies and the evidence to date on the effectiveness of different policies in reducing measures of systemic risks. Section 3 presents the data used and the results of the empirical analysis on the effectiveness of various macro-prudential policies in mitigating banking system vulnerabilities. Section 4 concludes, with reference to countries' situations, prospects and vulnerabilities, as to how macro-prudential policies can best be used. It also provides suggestions for further research.

II. REVIEW OF MACRO-PRUDENTIAL POLICIES USED AND THEIR EFFECTIVENESS

This section first reviews the macro-prudential policies toolkit that is available in principle. It then reviews the actual use of macro-prudential policies for a large sample of countries. It next reviews the existing literature on the effectiveness of macro-prudential policies. The next section then evaluates for these countries using bank level data and panel regressions the effectiveness of various tools and approaches to reduce vulnerabilities in banking systems.

A. The Toolkit Available

The macro-prudential policies toolkit available in principle is quite large, in part as it includes existing micro-prudential tools as well as new instruments. To mitigate causes of systemic risk and to reduce those externalities that contribute to adverse financial sector dynamics, a number of instruments have been proposed and some have been used, even before the recent global crisis.[2] Table 1 categorizes these measures in a 3-by-4 matrix (for other classifications, see Bank of England, 2011, Schoenmaker and Wierts, 2011, and IMF, 2011). The matrix covers along the vertical axes the goals of various types of policies, while along the horizontal axes the (intermediate) targets and methods are covered.

In reviewing the goals of various types of macro-prudential policies, it is useful to classify measures in three groups (rows, along the vertical axis). The first two groups are aimed at reducing the occurrence and consequences of cyclical financial risks, by respectively either dampening the expansionary phase of the cycle, or reinforcing the resilience of the financial sector to the adverse phases of the cycle. The third group is aimed at risks arising from interconnectedness and tries to ensure the internalization of spillovers.

Observers also tend to classify policies by intended target and method. Table 1 does this in four groups (columns, along the horizontal axis), namely: a) quantitative restrictions on borrowers, instruments or activities; b) quantitative restrictions on financial institutions' balance sheets; c) capital and provisioning requirements; and d) other, including more institutional-oriented measures, such as accounting changes, changes to compensation, etc. and taxation/levies on activities or balance sheet composition. Except for category a), these can all be seen as affecting the supply side of financing, while category a) aims to affect demand for financing. And while this overlap is less precise, tools in category a) and b) are more aimed at dampening the cycle, while categories c) and d) are more aimed at enhancing resilience.

Specific measures under each of the 12 (3*4) combinations include those correcting or compensating for fundamental factors that can give rise to externalities and market failures and those that compensate for policy factors that can contribute to adverse financial dynamics (such as the pro-cyclicality introduced by micro-prudential capital requirements). The measures in the first three columns are meant to be time-, institution-, or state-varying, while the ones in the fourth column are meant to be more structural. And some measures fall into more than one classification depending on how they are used. As noted, many of the measures are tools traditionally used for micro-prudential objectives; however, by making them vary by time, institution, or state of the world, they can be used to achieve macro-prudential objectives, such as dampening the amplitude of the cycle.

B. Preferred Use of Macro-Prudential Policies

The preferred use of macro-prudential policies will vary depending on the specific country's exposures to shocks and risks, and its structural, institutional and financial market characteristics

[2] Note that many of these instruments can also serve some other policy objectives, including, besides micro-prudential objectives, assuring consumer protection or fostering an appropriate level of competition.

that affect the amplification of financial and real sector cycles and the effectiveness of (specific) policies. For one, the country's financial structure, that is, the importance of banks versus capital markets is likely an important factor in the choice of policy. Financial institution–based measures for example, are likely of be of greater importance when much of the external financing comes from the regulated financial system.[3] Such financial structures can differ vastly across countries, including the ones being studied here. The industrial organization of the financial system may also matter. State-owned banks, for example, may on one hand be more likely to comply with macro-prudential policies (as they are more easily directed). On the other hand, state-owned banks might be formally exempted from some policies. They also have been shown to suffer from greater forbearance and be subject to political pressures, resulting in poor allocation of resources. Depending on the relative strength of these effects, this could make macro-prudential policies more or less effective with large state-owned bank presence. The degree of international financial integration will matter as well for the type of macro-prudential policy (and capital flow management) tools that can (best) be used. For example, in a country with a very open capital account and a large foreign bank presence, it will be harder to prevent the circumvention of (some) macro-prudential policies.

The use and effectiveness of policies could also vary depending on the availability and effectiveness of fiscal, monetary, and micro-prudential policies. For example, some countries can use monetary policy to affect the financial cycle, but for others, such as those in a currency union and having a pegged exchange rate, this option is not available (of course, even when available, the effectiveness of monetary policy is reducing systemic risks is not clear). Others may have high debt and less room to conduct countercyclical fiscal policy. And, the degree of financial openness will matter for the choice of policies, because it affects the degree to which some policies can be implemented and, more generally, determines a country's exposures (there are strong links between the behavior of capital flows and banking system vulnerabilities; see further Hahm, Shin, and Shin, 2013; and Claessens and Ghosh, 2013).

Preferred use could also vary depending on other elements of the broader policy toolkit available to mitigate systemic risks. Although only employed recently, some countries (e.g., US, EU) have been using stress tests to help identify financial system vulnerabilities and to identify specific remedial actions. Such stress tests are more forward-looking as many macro-prudential policies are static or not adjusted in a timely manner. They can also be less coarse in their applications (by having for example very granular asset categories for risk scenarios). More generally, they can be more tailored to (emerging) macroeconomic and financial vulnerabilities than macro-prudential policies can be, especially if the macro-prudential policies are not properly designed

[3] For instance, reserve requirements are more effective when as many deposit-like claims as possible are subject to it. Especially in advanced economies, however, many deposit-like claims are not directly regulated, or at least not to the extent of bank deposits, creating scope for avoidance. Of related importance is the development of the shadow banking system, since that is (by definition) less subject to (macro-prudential) policies. At the same time, the use of macro-prudential policies in the formal banking system could encourage the diversion of resources into the shadow banking system, thereby increasing the size of the shadow banking system.

to (changing) country circumstances. As such, stress tests can to some degree complement or substitute for the use of macro-prudential policies.[4]

Institutional environment constraints (e.g., lack of data, know-how and skills in supervisory agencies), political economy, and other factors may also lead countries to adopt macro-prudential policies in specific ways, possibly differently from what is otherwise preferable. Furthermore, financial reforms—both internationally coordinated (e.g., the new liquidity requirements announced in 2013) and country-specific (e.g., Vickers, Volcker, and Liikanen rules), are proceeding in a number of ways, making the overall institutional environment itself in flux. And, a major issue is that little is known on the actual effectiveness of various macro-prudential policies, meaning that usage has often proceeded on an ad-hoc or experimental basis.

C. Actual Use of Macro-Prudential Policies

Data on the actual use of macro-prudential policies in recent years have been collected through a survey of country authorities as well as through an internal IMF survey of country desk economists for a sample of some 48 countries, both advanced countries and emerging markets (see further Lim et al, 2011 for the exact coverage and definitions). The use is coded in the form of a dummy variable for each instrument that takes the value of 1 for countries and years in which that instrument is used or zero otherwise. The nine specific instruments covered are (Table 2): caps on loan-to-value (LTV) and debt-to-income (DTI) ratios, limits on credit growth (CG), limits on foreign lending (FC), reserve requirements (RR), dynamic provisioning (DP), counter-cyclical requirements (CTC), limits on profit redistribution (PRD), and a residual category (Other).[5] Only for some of the macro-prudential policies is the level also known: caps on LTV and DTI ratios, which vary from 0 to 1 and 0 to 0.5 respectively. To be consistent with the other macro-prudential policies, however, we use dummies to indicate the use of caps on LTV and DTI ratios.

Table 2 organizes these measures along the categories of Table 1: those aimed at borrowers (caps on LTV and DTI ratios); those aimed at financial institutions' assets (CG and FC) and liabilities (RR); those aimed at building buffers (DP, CTC, PRD); and the category Other. For our regression we mainly use these four groupings, but we also report results for the individual policies in some regressions.

In our sample a total of 35 countries—of which 25 are emerging markets and 10 are advanced countries—have implemented at least one of these instruments once during the period 2000-2010 and 13 countries have never used any of these instruments during this period (Table 2 provides the details, including when the tool was in use, although not necessarily continuously). Most usage of macro-prudential policies over this period is by emerging markets. This pattern is

[4] Stress tests, however, have some drawbacks. Typically they cover a subset of financial intermediation (mainly the major banks) and may therefore not capture all systemic risks. They are also less ex-ante in that actions to reduce systemic risks (e.g., need for recapitalization) would follow in a more discretionary way from the tests.

[5] Note that RR can also fulfill monetary policy functions (see Cordella, Federico, Vegh, and Vuletin, 2014). The category Other contains some macro-prudential policies not classified as well as some macro-prudential policies whose observance was coded independently, with the latter possibly overlapping to some degree with the other policies already classified.

consistent with the greater needs in emerging markets, both because they are more exposed to external shocks and because they tend to have more "imperfect" financial markets, and hence a more frequent necessity to tackle market failures.[6] It is also consistent though with their generally less liberalized financial systems.

We also differentiate between open and closed capital account countries on the basis of the country having a Chinn-Ito (2008) index of financial openness in 2005 above (33 countries) or below (15 countries) the median global index.[7] The capital account dimension is an analytically useful distinction as it indicates what risks are (more) important and affects the consequences that may need to be managed. On this measure, as expected, all advanced countries have open capital accounts, while in the case of emerging markets, some have relatively open capital accounts, but others like China and India, are relatively closed. In turns out that macro-prudential policies have been used somewhat more in closed capital account countries, reflecting perhaps these countries' generally less liberalized financial systems.

The usage statistics presented so far do not consider the length of time over which the specific policies have been used. Figure 2 provides the percentage of countries that have used any policy in a given year. As noted, there is a growing recognition of the value of macro-prudential policies. This is reflected in the strong trend of increased usage of macro-prudential policies since the 1990s, with emerging markets in particular using macro-prudential policies more, both before and after the recent crisis. On average, macro-prudential policies were four times more likely to be used by emerging markets than by advanced countries in the period right before the crisis (with this ratio declining to 3.3 after the crisis as advanced countries started to introduce macro-prudential policies). Differentiating between open and closed capital account countries leads to less sharp, but qualitatively similar differences.

Overall, countries use LTVs the most (Table 3, column 1): 24 countries used it at least in one year during this period. This is followed by dynamic provisioning (DP, 9 countries), foreign currency (FC, i.e., lending limits, 8 countries), debt-to-income (DTI, 7 countries), and credit growth (CG) caps and profit distribution restrictions (PRD), both used by 6 countries. These are followed by reserve requirements (RR, 5 countries) and finally counter-cyclical capital (CTC, 2 countries).

[6] There are also interactions between macro-prudential policies and capital flow management tools, in part because some policies operate in such a way that they can be considered a capital flow management tool (e.g., limitations on foreign currency exposures for banks that end up affecting mostly non-residents; see further Ostry et al., 2011, and IMF, 2012a). In addition, macro-prudential policies can affect the need for capital flow management tools. For example, by reducing the demand for loans, LTV caps can reduce the demand of banks for (whole-sale) funding, some of which may be in foreign exchange. Consequently, a LTV cap can indirectly reduce the need for capital flow management tools to be used.

[7] Note that we use the global median Chinn-Ito index, that is, the median within the whole Chinn-Ito (2008) dataset, not the median within this sample, which is why we have more open than closed countries. Also, as it is binary split, the closed account group still includes countries such as Brazil, Colombia, Russia and Turkey, for which capital flows are still very important from overall economic management and financial stability point of views. While there is no Chinn-Ito data for Serbia, we classify it in the open capital account group, since by all reports it has an open capital account.

Weighting by the length of time over which the macro-prudential policies are used (column 2 in Table 3), the most often used policy in the whole sample of countries is by far the LTV: in about 44% of the country-year combinations when a policy was used, it was an LTV. Next, besides the category Other, are four categories used about equally frequently: debt-to-income (DTI) and credit growth (CG) caps, foreign currency (FC) lending limits, and dynamic provisioning (DP), all used in about 8% of the cases each. These are followed by reserve requirements (RR), 5%, profit distribution restrictions (PRD), 3%, and finally counter-cyclical capital (CTC), 1%. Note that some countries used more than one policy at a time, so these figures are relative to the overall use of macro-prudential policies.

Use of a specific policy can also be expected to vary between advanced countries and emerging markets and between open vs. closed capital account countries in part as the source of systemic risks vary. In advanced countries, LTVs are used the most (Table 3, columns 3 and 4), with Canada, France, Hong Kong, Italy, South Korea, Norway, Singapore, Spain, and Sweden using the LTV over this period. Usage of other macro-prudential policies by advanced countries is rarer: only Hong Kong and South Korea use DTI, Singapore uses credit growth limits, Austria foreign exchange limits, Spain dynamic loan-loss provisioning, and Norway and South Korea Other tools. While LTV caps and foreign currency limits are used almost equally in both open and closed economies, reserve requirements are only used in relatively closed capital account countries (Table 3, columns 5 and 6). This likely reflects differences in both risk exposures and financial system structures, and possibly the degree of financial liberalization. Otherwise, the differences in the use between open and closed economies are not as stark as those between emerging markets and advanced countries.

Differences between emerging markets and advanced countries' use of specific policies are starker when considering the length of time over which the policies are used (columns 7 and 8 of Table 3, which report usage percentages by country-year observations for each group). Emerging markets use a much broader set of policies over a longer period than advanced countries do. Maybe because emerging markets tend to be more concerned with large and volatile capital inflows and with related systemic liquidity risk, they tend to favor relatively more capital flow- and liquidity-related related policies (FC, RR). But they also use limits on credit growth more often, possibly in part because they tend to have less liberalized financial systems. They also tend to rely somewhat more on limits on profit distributions. On the other hand, as noted, advanced countries tend to mainly prefer the demand for credit related measure LTVs (74% of their usage by country-year observations). They also use DTI and dynamic provisioning somewhat more than emerging markets do. This suggests that advanced countries are relatively more concerned with risks arising from excessive leverage, and the consequent de-leveraging.

D. Effectiveness of Macro-Prudential Policies: Existing Studies

Some existing papers have analyzed the effects of macro-prudential policies on various measures of financial vulnerability and stability (see further IMF (2012b and 2013b) and Claessens (2015) for recent reviews of studies). Lim et al. (2011) explore the role of macro-prudential policies and document evidence of some policies being effective in reducing the procyclicality of credit and leverage. Specifically, using cross-country regressions, they find that tools such as LTV and DTI caps, ceilings on credit growth, reserve requirements, and dynamic provisioning rules, can mitigate the "procyclicality" of credit.

IMF (2012b) also investigates in a cross-country context the effectiveness of (changes in) policies on financial vulnerabilities (credit growth, house prices, and portfolio capital inflows) and any effects on the real economy (output growth, and sectoral allocation, i.e., the share of residential investment), and examines whether the effects of policies are symmetric between tightening and loosening. Overall, they find that both (time-varying) capital requirements and RRs have statistically significant effects on credit growth, that LTV limits and capital requirements (but not RRs) have strong effects on house price appreciation rates, and that RRs reduce portfolio inflows in emerging markets with floating exchange rates. They cannot reject the hypothesis that the effect of policies is symmetric, rather than asymmetric. Their evidence also suggests that limits on LTV impact output growth, perhaps working through a reduction in construction investment, but that other policies show little evidence of directly affecting output.

Crowe et al. (2011) explore the effects of policies like LTVs on real estate booms and busts. They find that policies such as maximum LTV linked to the real estate cycle appear to have the best chance to curb a boom. They argue that the narrower focus of such tools reduces their costs. And, for measures aimed at strengthening the banking system (such as dynamic provisioning), even when failing to stop a boom, they argue that such tools may still help to cope with the bust. Vandenbussche, Vogel, and Detragiache (2012) investigate whether macro-prudential policies had any impact on house price inflation in Central, Eastern, and Southeastern European countries. Their evidence suggests that measures like capital ratio requirements and non-standard liquidity measures (marginal RR on foreign funding or linked to credit growth) helped slow down house price inflation.

Dell'Ariccia et al. (2012) conduct an empirical investigation of the use of macro-prudential policies in mitigating general credit booms and busts. Their results suggest that macro-prudential policies can reduce the incidence of credit booms and decrease the probability that booms end up badly.[8] Consistent with the focus of policies on financial vulnerabilities, they find a reduction in the probability of a bad boom, primarily for those booms that end up in a financial crisis, although the effect on the probability of economic underperformance is not very different. They conclude that macro-prudential policies can reduce the risk of a bust, while simultaneously reducing the vulnerability of the rest of the economy to troubles in the financial system.

Kuttner and Shim (2013), using data from 57 countries for more than three decades, investigate the effectiveness of nine non-interest rate policy tools, including macro-prudential measures, in stabilizing house prices and housing credit. Using conventional panel regressions, housing credit growth is significantly affected by changes in the maximum debt-service-to-income (DSTI) ratio, the maximum LTV, limits on banks' exposure to the housing sector and housing-related taxes. But only the DSTI ratio limit has a significant effect on housing credit growth when they use mean group and panel event study methods. And of the policies considered, a change in housing-related taxes is the only one with a discernible impact on house price appreciation.

[8] When estimating regressions using the subcomponents of their macroprudential index, they find that credit and interest controls and open foreign exchange position limits enter significantly in most regressions, although their significance depends on the specific combination of variables included.

Besides these more aggregate, cross-country studies, there are also case studies, often focused on specific risks or market segments, and using micro data. Jiménez et al. (2012) find for the case of Spain that countercyclical macro-prudential policies, such as dynamic provisioning, are useful in taming credit supply cycles. Importantly, they find that dynamic provisioning helps smooth the downturn during recessions, upholding firm credit availability and performance. Igan and Kang (2012) find evidence of beneficial effects of LTV and DTI limits on mortgage credit growth in Korea. And for the case of the UK over the period 1998-2007, Aiyar, Calomiris, and Wieladek (2013) find that bank-specific higher capital adequacy requirements dampened lending by individual banks (whereas tighter monetary policy did not affect the supply of lending).

There are also cases where macroeconomic tools were used that can be interpreted with a macro-prudential perspective. Dassatti Camors and Peydro (2014) investigate the effects of a large and unexpected increase in RR in Uruguay in 2008 using detailed, bank-firm matched data. Their evidence suggests some ambiguous results. While aggregate credit growth declines, some more risky firms get more credit. They also document that larger and possibly more systemic banks are less affected. There may thus be tradeoffs using RR, since less credit does not necessarily mean less systemic risks (RR may still be beneficial as macroeconomic tool).

III. ANALYSIS OF EFFECTS OF POLICIES ON BANKING SYSTEM VULNERABILITIES

This section provides new analysis on the effectiveness of macro-prudential policies in terms of mitigating banking system vulnerabilities. It first describes the data used and then analyzes the effectiveness of the various policies countries have used.

A. Data Used For Analysis

We perform our analysis using the panel data set of macro-prudential policies actually used (described above) and relate these to measures of banking system vulnerabilities. In particular, we study changes in banks' total assets.[9] Our main data source for the bank balance sheet data is the Bankscope database, which standardizes balance sheet statements to adjust for variations in accounting and auditing conventions so that they are (reasonably) comparable. The sample of banks is chosen so that for each country, we cover the top 100 banks based on total assets (or less if only fewer banks exist). This way we avoid the sample being dominated by advanced countries where there are many banks, such as the US, Germany, and Japan. We use unconsolidated data, so that we also cover individual subsidiaries of foreign banks.

All financial statement data are annual and in US dollars.[10] To remove the effect of outliers (possibly due to misreporting or other data problems), we winsorize all observations, discarding bank balance sheet ratios above (or below) the five percent level in both tails of the distributions. We end up with some 18,000 observations on 2,820 banks in 48 countries over the period 2000-

[9] We also analyzed changes in two other bank balance sheets variables: leverage (the bank's total assets to total equity ratio) and noncore-to-core liabilities, but did not find strong results for these variables.

[10] Since we are limited to annual bank balance sheets data, we cannot study the effects of intra-year changes in macro-prudential policies (some countries, like Korea, have altered macro-prudential policies within a single year, see Igan and Kang, 2012). However, since such changes are rare and more general macro-prudential policies are not meant as short-term risk management tools, we do not expect our results to be affected.

2010, of which 1,609 are in 23 advanced countries and 1,212 in 25 emerging markets. We also need to control for individual bank conditions as banks' ability to adjust their asset size may vary with factors such as their initial leverage and funding structures.

Table 4A provides summary statistics of the dependent and independent variables used. It shows the large variation in asset growth across individual banks, even after the removal of outliers. Asset growth is on average 13% per year, but varies also greatly among banks, from -38% to 77%. As we cover many countries, some with small banking systems, the banks included vary greatly in size, from $10 million to the largest being $3.9 trillion. While average leverage is 14, some banks are very lowly leveraged, having a debt to equity ratio of just 1, whereas the highest leveraged bank has a ratio of 40. Also, while the average loan to deposit ratio is 1.47, some banks rely less on deposits and for these the ratio of loans to deposits can reach up to 6.36.

Differences between the groups of advanced countries and emerging markets are as expected, with the average growth rates in assets higher in emerging markets than in advanced countries. This reflects the general financial cycles in these two groups of countries, with advanced countries also experiencing more downturns over this period. Banks are typically smaller in emerging markets, less leveraged, and more dependent on deposit to fund loans than in advanced countries (since we winsorize the data, extreme values can be identical between the groups). Closed differ from open capital account economies in many ways similar as emerging markets differ from advanced countries, with closed countries having higher asset growth and generally greater volatility in financial variables between booms and busts. This could be because capital account restrictions are adopted by those countries more exposed to systemic risks, including due to global shocks. Or it could be that more closed countries are less well-developed financially and institutionally, which make them more prone to (external) shocks.

We differentiate between upswing and downswing (boom and bust) years depending on whether overall real credit in the specific country increases or decreases in that year (note that some countries did not experience any decline in credit over this period). Table 4B makes clear that the boom and bust parts of the cycles are different in terms of banks' balance sheets behavior. It also shows that booms and busts vary between countries, i.e., emerging markets (open) versus advanced countries (closed capital account countries). For example, the typical expansionary phase is stronger in emerging markets than in advanced countries, with larger asset growth. The typical contractionary phase is less severe though in terms of bank variables in emerging markets than in advanced countries. Some differences reflect that over this period advanced countries faced more periods with declines in overall credit. Overall though booms and busts tend to be more intense in emerging markets (see also Claessens et al., 2010; and Claessens and Ghosh, 2013).

Given country differences, it is important to control for country characteristics and conditions. In the regressions, we therefore include, besides country-fixed effects, various time-varying country controls, with annual data obtained from the IMF's International Financial Statistics (IFS) and other sources. We include the real GDP growth rate to proxy for the state of the country's business cycle, as that will affect demand for funds and whether banks are more likely to expand or contract their balance sheets. We include the change in interest rates to control for the monetary policy stance, which can be expected to affect the country's financial cycle, including

the degree of risk-taking. We also control for the country's exchange rate arrangement, with a measure varying from 0 for a completely fixed (i.e., a de facto peg or membership of a currency zone) to 6 for a free-float regime.[11]

Raw statistics for these country variables, including the use of macro-prudential policies, are presented in Table 4A. In terms of real GDP growth, emerging markets tend to outperform advanced countries, 4.79% vs. 1.79%. In terms of the policy interest rate, while emerging markets have higher rates than advanced countries do over the period 2000-2010, they moderate their rates less than advanced countries. And countries differ also widely in structural characteristics. For example, exchange rate arrangements vary from belonging to a currency union (e.g., Spain, Germany) to being freely floating (e.g., US, Australia, Japan).

Since 35 countries have adopted at least one macro-prudential policy tool and 13 have adopted none at any time during 2000-2010, we have in principle both good sized treatment and control groups. Importantly, though, there are differences between those countries that have used macro-prudential policies and those that have not that can confound our analysis. For example, the median increases in bank leverage and assets are larger for those countries that have used macro-prudential policies that those that have not (Table 4B). This suggests that those countries experiencing larger increases in financial risks have a greater willingness to adopt macro-prudential policies. These aspects confirm the need to control for endogeneity in the adoption of macro-prudential policies.

B. Empirical Model

We want to assess the effects of macro-prudential policies on asset growth, comparing the use of each instrument with an alternate scenario where the instrument is not used. The empirical model we use is Generalized Method of Moments (GMM) panel regressions. The GMM model is advantageous because it corrects for the biases introduced by endogeneity problems (e.g., countries that use a policy may do so in response to concerns about systemic risk, captured in part by our dependent variables).[12] We test for every regression that the GMM system estimator satisfies the orthogonality hypothesis between the lagged endogenous variables. Lagged dependent variables (up to lag 4), also including credit growth, and time and country-fixed effects are used as instruments and are weighted such as to minimize the asymptotic variance of the estimator.

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[11] Exchange rate arrangements can matter in two ways for vulnerabilities. A more fixed exchange rate arrangement can limit monetary policy as an instrument to mitigate cycles and it may thus mean more booms (and busts). Related, it may also mean some moral hazard as the fixed rate implies a more explicit form of public insurance for the banking system. At the same time, exchange rate arrangements can affect our measures of banking system vulnerabilities since these are recorded in US dollars. This means that, depending on the local vs. foreign currency composition of banks' balance sheets, fluctuations in the dollar-local currency rate can get (more) reflected in our measures if the exchange rate is (more) flexible.

[12] Note that since we study the behavior of individual banks, there is much less risks of endogeneity compared to country studies. In country-based studies, the likelihood that macro-prudential policies are adopted in response to the behavior of the credit, leverage or other financial system variables is considerable. This implies a possible bias when studying the effects of macro-prudential policies on these aggregate variables. In our case, feedback from individual bank risk variables to the adoption (or removal) of policy is much less likely as each bank represents only a (small) part of overall financial intermediation. Nevertheless, using GMM should help with removing any residual endogeneity.

We thus define the base regression model as follows:

$$\Delta Y_{i,c,t} = \alpha + \lambda * \Delta Y_{i,c,t-1} + \beta * MaPP_{j,c,t} + \varphi * MaPP_{j,c,t} * \Delta Y_{i,c,t-1} + \theta * X_{c,t-1} + \\ + \mu * Z_{i,c,t-1} + \varepsilon_{i,c,t}^{MaPP}$$

For each bank *i* in country *c* in year *t*, $Y_{i,c,t}$ represents the change in respective bank risk variable (asset growth in the primary regressions, and changes in the leverage and non-core to core ratios in the robustness tests). In terms of right-hand side variables, all regressions include a lagged dependent variable, to allow for natural convergence. We control for individual bank conditions by including a vector $Z_{i,t-1}$ which consists of a bank's leverage and liquidity (ratio of loans to deposits) positions in the previous year. To control for macroeconomic developments and policies, we include a vector $X_{c,t-1}$ of (lagged) variables. In all regressions, we include year-fixed effects, to control for any (remaining) time-varying effects, such as changes in global economic or financial conditions (as well as US dollars inflation), and individual country-fixed effects, to control for any time-invariant country circumstances.

In terms of the policy variables of interest, in the base regression the matrix $MaPP_{j,c,t}$ is our set of dummy variables that take the value of 1 during years in which a (group of) policy instrument *j* is used in country *c* and zero otherwise. Countries that never use any instrument are thus included, with values of zero for all instruments.

We first explore specific combinations of macro-prudential policies (using the four-way classification of Tables 1 and 2): 1. borrower based (caps on LTV and DTI ratios); 2. financial institutions' asset- (CG and FC) and liabilities-based (RR); 3. financial institutions' buffer-based (DP, CTC, PRD); and the residual 4th category (Other). We group this way as there may be interactions within a group. For example, DTI and LTV can be substitutes, in that both can lower the amount of loans that can be extended. Or they can be complements, as when, if borrowers obtain loans beyond those limited by the LTV cap (including on the same house), a cap on the DTI would still limit overall debt (service) obligations. Besides including these groups one-by-one in regressions, we also include all four groups together in one regression, as there may be complementarities and other interactions across the groups. Financial institutions' liabilities-based policies for example could be less or more effective when at the same time the country also has LTV limits, a borrower-based policy. Or when having buffer types of policies in place, tools like borrower-based tools may be less effective.

We also investigate whether the effects of specific policies vary by the intensity of the changes in the bank risk variable since we can expect tools to be more effective when the financial cycle is more extreme. We do this by including in the regression $MaPP_{j,c,t} * \Delta Y_{i,c,t-1}$, i.e., the interaction between the specific policy and the respective lagged bank risk variable, calculated as a matrix. Significant coefficients would indicate that the policies are more effective when the financial cycle is more intense. We also run regressions with each of the nine policies individually to see which one is driving the main results.

As noted, we want to investigate whether there are differences between the effects of policies during expansionary and contractionary financial phases. While macro-prudential policies are mainly aimed at reducing the buildup of vulnerabilities, and as such should be most effective during an expansionary period, they may also help mitigate declines in financial intermediation

during contractionary periods. As discussed (see also Table 1), LTV, DTI, CG, and FC are typically seen to mitigate upswings. And policies such as RR, DP, CTC, and PRD are seen as building buffers that can be drawn down in the adverse part of the cycle, and thereby mitigate contractions. Some policies, such as RR and DP, may be effective both in term of limiting expansions or mitigating declines. Note that this means that the expected sign on the policy dummy should change: negative in expansionary periods—when a policy lowers the buildup of bank vulnerabilities, and positive in contractionary periods—when it mitigates declines. To investigate whether tools are particularly effective in mitigating expansions or reducing corrections, we conduct therefore regressions including dummies differentiating expansions from contractions on the basis of aggregate credit.

We also investigate if results vary between advanced countries and emerging markets by including interaction dummies in the base and phases regressions (note, we do not need to include a separate dummy on whether the country falls in the group of emerging markets vs. advanced countries, since we always use country-fixed effects).[13] And while we already use country-fixed effects, thus controlling in general for time-invariant differences between countries, we also include variables to capture time-varying country changes.

C. Regression Results

Table 5 reports the base results. While the full sample consists of some 2,800 banks in 48 countries, because some bank variables are not always available and since we drop outliers and use lag dependent variables (up to the 4th), the sample reduces to some 2,630 (1,670) banks and 13,800 (8,500) observations in the base (subsequent) regressions. Column (1) presents the results of regressing the asset growth variable on only its own lag and our country- and bank-specific control variables. The coefficient on the lagged dependent variable is negative here as well as in the other regression results, indicating that there are some natural mitigating forces making assets not increase or decrease unboundedly. For example, when asset growth is high this period, it can be expected to increase less next period, since there are limits on banks' balance sheets expansions, like capital adequacy requirements, and market discipline may also act as a mitigating force on individual institutions.

In terms of country variables, we find that lagged real GDP growth has the expected positive sign and is significant, indicating that the state of the real business cycle positively affects asset growth, even when we control for the presence of a financial cycle using the lagged dependent variable. This significance is generally maintained across regression specifications. Monetary policy (change in interest rate) does not seem to play a consistent role in curbing banks' risks, and is actually significantly positive for asset growth in the base regression, but mostly insignificant in other specifications. The lack of effect is consistent with the general literature that finds that large increases in interest rates are needed to stop credit booms. (When we differentiate between up- and downswings, however, we find the interest rate to be statistically significant negative in downswing, confirming that a lowering of interest rate helps to mitigate asset declines during busts). The type of exchange rate regime is not significant, but the negative

[13] Since there are less stark differences in use of macro-prudential policies between closed and open capital account countries, we do not consider this breakdown.

sign still suggests asset growth is lower with exchange rate regimes that are more of the freely–floating type. Such countries may have less volatile financial cycles in part as the exchange rate absorbs some of the capital flow pressures.

The coefficients on the bank-specific variables are largely as expected when significant. Specifically, the coefficient on lagged leverage is negative and generally statistically significant, indicating it limits banks' expansion, i.e., banks with already high leverage positions tend to have lower asset growth. This contrasts, however, with the findings of Adrian and Shin (2010), where highly leveraged investment banks in the US were more likely to see their assets grow faster. Their finding, however, may be specific to these types of banks in advanced countries. The sign for the degree to which the bank relies on deposit funding for loans is less clear a priori, in part since funding can adjust faster than capital positions. On the one hand, banks with higher loan to deposit may be riskier and more willing to expand their balance sheets. On the other hand, an already high ratio may restrain banks from being able to do so. This ambiguity is reflected in the fact that the coefficient on the loan to deposit ratio is insignificant.

Regression results in column (2) consider the four groups of macro-prudential policies one by one. We only show the coefficients for the policies, but all regressions have the usual lag dependent, country variables and fixed effects as well as controls for key bank-level variables. We find that borrowers' based measures (LTV and DTI) reduce asset growth in a statistically significant way, with these policies decreasing asset growth by about 0.44 percentage points. Banks' balance sheets related measures (controls on credit growth and foreign currency lending, reserve requirements) also reduce the growth of assets, by 0.66 percentage points. Buffer-oriented measures (countercyclical capital requirements, dynamic provisioning, limits on profit distributions) do not affect asset growth in a statistically significant way. The group of Other policies also has the expected negative effect, of some 0.67 percentage points.

We next conduct regressions to investigate the effectiveness of policies taking into account the intensity of the cycle (column 3). We find the overall results to be confirmed, but no specific statistically significant effects for the four policies related to the intensity of the financial cycle. We also conduct a regression where we include the four groups simultaneously. Results (column 4) suggest that the balance sheets oriented and the Other categories best capture the overall effect of macro-prudential policies, with impacts of 1 and 0.72 percentage points respectively.

We next conduct regressions where we include each individual macro-prudential policy one by one only (column 5). We find results to be consistent with the group-based regression results. Of the measures aimed at borrowers, LTV is statistically significant negative, with an effect of 0.85 percentage points. Of those aimed at banks' asset and liabilities side, the limit on CG is statistically significant, with an effect of 0.70 percentage points, but the others, while negative, are not statistically significant, i.e., they are not effective in mitigating the financial cycle. And of the measures aimed at addressing banks' buffers, only the countercyclical capital requirement (CTC) is statistically significant negative. Profit distribution restrictions, while not statistically significant, appears counterproductive as it is positive. We lastly conduct a regression where we include the nine policies simultaneously (column 6). It confirms the importance of CG and Other, while FC is now also statistically significant negative. And while the LTV is no longer significant, the DTI becomes positive and statistically significant.

Some of the less statistically significant or counter-intuitive effects could be reflect that measures can operate in an opposite way during downturns, in that they limit the decline in asset growth, making their overall effects ambiguous. Next we therefore repeat the same regressions with the four groupings, except considering expansionary vs. contractionary periods. Thus we include a dummy when aggregate credit in the country is in a downswing and we also interact this dummy with each of the four groups of policies, where we use the general credit cycle in the country to determine the phase (note that the dependent variable, individual bank risk, may be in a phase different from the general country credit cycle). As over this period credit is generally expanding, the number of observations in expansionary periods (some 6,700) is larger than in contractionary periods (some 1,600).

Table 6 reports these regression results, with the four columns reporting results for one policy group and interaction at a time. The coefficients for the country and bank control variables confirm the general regression results: the lag dependent variable is statistically significant negative and higher GDP growth is most often significantly associated with higher asset growth.[14] Asset growth is generally lower in downswings as the statistically significant negative coefficients for the downswing dummy show. Results including the four groups of policies one-by-one and interacting them with the phase of the cycle show that macro-prudential policies are somewhat more effective in booms than they are in busts.

Considering the coefficients for the four groups of policies in general, we find significant negative effects for the borrower-based, bank balance sheets-based and Other policies. This suggests again, consistent with regression results reported in Table 5, that these policies help mitigate asset growth, with effects largely present during booms. Only for the buffer-based policies do we again not find a statistically significant effect. For the contractionary periods, only borrower-based policies help limit the decline in assets growth, as the sign is statistically significant positive. None of the other policies are statistically significant in mitigating asset declines in downswings. Still, measures aimed at banks' asset and liabilities side as group and the category Other have positive signs (with significance levels of 25% and 16% respectively), suggesting some effectiveness in mitigating downturns and potential systemic credit crunches. Measures aimed at building banks' buffers—so as to limit banks' need to reduce their assets during bad times, are not productive (a caveat is that few countries have used these policies).[15]

[14] Unreported regression results for the separate samples of downswing and upswing observations show that splitting by phase is important as the change in interest rate is only statistically significant negative during downswings, suggesting that lower interest rate help to mitigate declines in asset growth, but not to reduce asset growth during upswings. Higher loan to deposit ratios are more likely associated with increases in asset growth during upswings (albeit not statistically significant), consistent with the finding of Adrian and Shin (2010) that during booms funding is procyclical, but with lower asset growth during downswings, likely as a shortage of funding is a drag on maintaining asset growth.

[15] When including all policies at the same time (not reported), some of these results are confirmed. Specifically, we find that in upswings Other help limit asset growth, while during downswings, they help limit asset growth declines. Considering also the intensity of the cycle, borrower–based policies do more to support asset growth when assets declines are larger, while Other do less so. And bank balance sheets–based measures operate perversely during downswings as they aggravate asset growth declines.

That policies are mostly effective in expansionary times and less so during contractionary periods may not surprise, as most macro-prudential policies are not designed to mitigate contractions as such. It could even be that tools like balance sheets-based limits actually act perversely during periods of credit contractions and asset price declines. As banks' and borrowers' net worth and income decline, for example, strict limits can make it even harder for lenders to extend loans. Unless limits are adjusted quickly and calibrated correctly, that is, without unduly increasing systemic risks, policies may act perversely as they lead to further declines in asset prices and economic activity, setting off a perverse cycle of even tighter ratios.

Lastly, we compare the effectiveness of macro-prudential policies in emerging markets versus the other group of advanced countries. We do this by including an interaction term with a dummy whether the country is an emerging market or not. Table 7 reports the regression results; showing the regression results of regressing policies one by one (column 1), simultaneously (column 2), and taking into account the intensity of the cycle (column 3).

We find that the significance of the borrower-based measures for the overall sample is more due to the advanced countries as the positive coefficient for the emerging markets dummy offsets the negative sign for the whole sample (column 1). Otherwise there are no statistically significant differences between emerging markets and advanced countries in this specification. When considering all policies simultaneously (column 2), we see again the positive significant sign for the borrower–based policies in case of emerging markets, offsetting the general negative sign. At the same time, the negative effect for the group Other for the whole sample seems more driven by the emerging markets sample as the interaction coefficient is statistically significant negative there. When also considering the macro-prudential policies interacted with the intensity of the financial cycles (column 3), we find that the borrower-based policies work mostly for advanced countries, but more so for emerging markets when the cycle is more intense there. The buffer-based work more when the cycle is more intense for advanced economies, but not so for emerging markets, while Other works again well for all countries and irrespective of the cycle.

IV. CONCLUSIONS

Recent theoretical advances and policy thinking support a role for macro-prudential policies in safe-guarding financial stability. Such policies can reduce the buildup of vulnerabilities and can help mitigate the impact of adverse cycles by encouraging a greater buildup of buffers. Our analysis confirms that countries stand to benefit from greater use of macro-prudential policies to reduce the risk arising in their banking systems. Using a large panel data set of individual bank balance sheets, we find that some macro-prudential policies reduce the growth in assets. We find in particular caps on borrower and financial institutions' assets and liabilities–based measures to be effective, while buffer-based policies seems to have little impact on asset growth. Overall, there is little evidence that the effectiveness of these tools varies by the intensity of the cycle.

When we differentiate the effectiveness of policies in reducing vulnerabilities by phase of the financial cycle, we confirm that many help reduce risks during upswings. In contraction phases, however, most tools seem to be less effective in maintaining financial intermediation. This is to be expected since many policies are more suited to reducing the buildup of vulnerabilities, while only some are more geared towards building up buffers. However, even tools which help build

buffers in good times generally do not help to provide cushions that alleviate crunches during downswings. As such, macro-prudential tools may be less promising to mitigate adverse events.

There are large differences across countries in the usage of macro-prudential policies, with emerging markets and closed capital account countries using these policies relatively more than advanced countries and open capital account countries. We find some evidence that some policies are somewhat more effective at curbing risks in advanced countries and others in emerging markets. Notably, borrower-based measures seem to work better in advanced countries. This ought not to surprise, given that real estate boom and bust cycles are more important in determining their overall financial cycles. There is also some evidence that a package of macro-prudential policies works better in emerging markets, perhaps as their financial systems are less liberalized, allowing a combination of policies to be used. We also conjecture that there could be both complementary and substitution relationships between macro-prudential policies and capital flow management tools, with the latter used more in emerging markets.

As documented, emerging markets have been at the forefront of using macro-prudential policies. In light of recent events one may, however, question whether emerging markets are more exposed to risks and more in need of these policies. In principle, all types of countries can experience the externalities and market failures that macro-prudential policies try to address. In practice nevertheless, the choice of what policies (if any) to use will have to be country- and circumstance-specific, as some of our findings suggest. While in some respects, systemic risks concerns are becoming similar across countries, emerging markets likely need to use a different and broader set of policies, including, besides the traditional monetary, fiscal, and micro-prudential policies, macro-prudential and capital flow management tools. At the same time, their general pragmatic approaches to date can benefit from further research on what are the most effective and efficient approaches given specific conditions (see also Acharya, 2013, and Shin, 2013, on how to adapt policies, especially to emerging markets and developing countries).

Our work comes with caveats and related suggestions for future research. Residual selection, endogeneity and omitted variables problems can still drive our results. Propensity scoring could be used to control to some degree for country selection issues. Techniques such as matching banks from different macro-prudential policy regimes could address another type of selection problem. Another way to control for bank characteristics would be to study how subsidiaries of the same foreign bank behave in countries with different macro-prudential policies. While this would reduce the number of observations significantly, as few global banks have operations in many countries, it would control for otherwise difficult to capture bank-specific aspects, such as the quality of its risk management.

A major issue is how to account for circumventions and risk transfers to other, possibly less regulated parts of the financial system. Our regression results indicate that (some) macro-prudential policies are more effective in reducing vulnerabilities in banks. It could, however, be that these policies are also more easily avoided by channeling financing through less regulated parts of the financial system (note that this applies less to those macro-prudential policies aimed directly at borrowers as those are less likely to be avoided). As such, using macro-prudential policies need not be associated with less overall systemic risks or reduced financial cycles.

One way to investigate this possibility is to use more aggregate financial measures, as has been done in some studies using overall credit development. This has its own (econometric) caveats, however, including greater concerns for endogeneity. Another way is to investigate how complementary, market-based measures, such as asset prices (including credit spreads) and systemic risk rankings (e.g., those based on Marginal Expected Shortfall Measures, as developed in Acharya et al., 2010, or CoVaR, as developed in Adrian and Brunnermeier, 2011) respond to various macro-prudential policies. By being less institutions' specific and possibly more comprehensive, such measures may suffer less from issues of circumvention. These and other extensions are left for future research, in part as many of these measures and underlying data are not (yet) available for a large sample of countries and a long time period.

Finally, while our results suggest that macro-prudential policies can be important elements of the toolkit aimed at overall systemic risk mitigation especially for countries exposed to international shocks, the adoption of such policies may also entail some costs. In particular, in as much as macro-prudential policies affect resource allocations, they may affect economic activity and growth and/or possibly limit (efficient) financial sector development. This is likely to be a fruitful area of research as well.

REFERENCES

Acharya, Viral, 2013, "Adapting Micro-prudential Regulation for Emerging Markets", Report commissioned by the World Bank's Poverty Reduction and Economic Management (PREM) Network, May (Washington: The World Bank). In Otaviano Canuto and Swati R. Ghosh (eds.), *Dealing with the Challenges of Macro Financial Linkages in Emerging Markets,* World Bank, Washington, D.C. pp. 57-89.

Acharya, Viral, Christian Brownlees, Robert Engle, Farhang Farazmand and Mathew Richardson, 2010, "Measuring Sytemic Risk" in Acharya, Viral, Thomas Cooley, and Mathew Richardson (Eds.), *Regulating Wall Street: The Dodd-Frank Act and the New Architecture of Global Finance,* John Wiley and Sons.

Adrian, Tobias, and Markus K. Brunnermeier, 2011, "CoVaR," NBER Working Paper 17454.

Adrian, Tobias and Hyun S. Shin, 2010, "Liquidity and Leverage," *Journal of Financial Intermediation* 19(3), pp. 418-437.

_____, 2014, "Procyclical Leverage and Value-at-Risk", *Review of Financial Studies*, 27 (2), 373-403.

Aiyar, Shekhar, Charles W. Calomiris and Tomasz Wieladek, 2013, "How Does Credit Supply Respond to Monetary Policy and Bank Minimum Capital Requirements?," mimeo, Columbia University.

Bank of England, 2009, "The Role of Macroprudential Policy". Discussion Paper. November.

Bank of England, 2011, "Instruments of Macroprudential Policy," Discussion Paper. December.

Borio, Claudio E.V. and William R. White, 2003, "Whither Monetary and Financial Stability: the Implications of Evolving Policy Regimes?" – in *Monetary Policy and Uncertainty: Adapting to a Changing Economy*, Conference Volume, Federal Reserve Bank of Kansas City.

Brunnermeier, Markus K., Charles Goodhart, Andrew Crocket, Avinash Persaud, and Hyun Shin, 2009, *The Fundamental Principles of Financial Regulation: 11th Geneva Report on the World Economy*. CEPR/ICMB.

Claessens, Stijn, 2015, "An Overview of Macroprudential Policy Tools", *Annual Review of Financial Economics*, forthcoming.

Claessens, Stijn, Douglas D. Evanoff, George G. Kaufman, and Laura Kodres, 2011, *Macro-prudential Regulatory Policies: The New Road to Financial Stability.* (Eds.), World Scientific Studies in International Economics, Pte. Ltd, New Jersey.

Claessens, Stijn and Swati R. Ghosh, 2013, "Business and Financial Cycles in Emerging Markets: Lessons for Macro-Prudential Policies," forthcoming in Dongsoo Kang and Hyun Song Shin (Eds.). *Financial Regulations on International Capital Flows and Exchange Rates*, the East-West Center and the Korea Development Institute.

Claessens, Stijn, M. Ayhan Kose, and Marco E. Terrones, 2010, "Financial Cycles: What? How? When?" in *NBER International Seminar in Macroeconomics 2010*, ed. by Richard Clarida and Francesco Giavazzi (Chicago, Illinois: University of Chicago Press).

Chinn, Menzie D. and H. Ito, 2008, "A New Measure of Financial Openness," *Journal of Comparative Policy Analysis*, 10:3, pp. 309–22.

Cordella, Tito, Pablo Mariano Federico, Carlos A. Vegh, and Guillermo Vuletin, 2014, "Reserve Requirements in the Brave New Macroprudential World". World Bank Policy Research Working Paper No. 6793.

Crowe, Chris W., Giovanni Dell'Ariccia, Deniz Igan, and Pau Rabanal, 2011, "How to Deal with Real Estate Booms: Lessons from Country Experiences" IMF Working Paper, No. 11/91, (Washington: International Monetary Fund).

Dassatti Camors, Cecilia and Jose-Luis Peydro, 2014, "Macroprudential and Monetary Policy: Loan-Level Evidence from Reserve Requirements", mimeo, Universitat Pompeu Fabra, Spain.

De Nicolò, Gianni, Giovanni Favara, and Lev Ratnovski, 2012, "Externalities and Macroprudential Policy". IMF Staff Discussion Notes, No.12/05. (Washington: International Monetary Fund).

Dell'Ariccia, Giovanni, Deniz Igan, Luc Laeven, and Hui Tong, 2012, "Policies for Macrofinancial Stability: Options to Deal with Credit Booms," IMF Staff Discussion Note SDN/12/06 (Washington: International Monetary Fund).

Hahm, Joon-Ho, Hyun Song Shin, and Kwanho Shin. 2013, "Noncore Bank Liabilities and Financial Vulnerability," *Journal of Money, Credit and Banking*, 45(S1), 3-36.

Hanson, Samuel, Anil Kayshap, and Jeremy Stein, 2011, "A Macroprudential Approach to Financial Regulation*," Journal of Economic Perspective*, 25(1), Winter, pp. 3–28.

Igan, Deniz, and Heedon Kang, 2011, "Do Loan-to-Value and Debt-to-Income Limits Work? Evidence from Korea," IMF Working paper No. 11/297 (Washington: International Monetary Fund).

Jiménez, Gabriel, Steven R. G. Ongena, Jose-Luis Peydro, and Jesus Saurina Salas, 2012, "Macroprudential Policy, Countercyclical Bank Capital Buffers and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments," European Banking Center Discussion Paper No. 2012-011.

International Monetary Fund, 2011, "Macroprudential Policy: An Organizing Framework," Board Paper, April (Washington: International Monetary Fund).

———, 2012a, "The Liberalization and Management of Capital Flows — An Institutional View." IMF Policy Paper, April (Washington: International Monetary Fund).

———, 2012b, "The Interaction of Monetary and Macroprudential Policies." IMF Board Paper and Background Paper, January (Washington: International Monetary Fund).

_____, 2013a, "Key Aspects of Macroprudential Policy," IMF Policy Paper, June (Washington: International Monetary Fund). http://www.imf.org/external/np/pp/eng/2013/061013b.pdf

_____, 2013b, "Key Aspects of Macroprudential Policy - Background Paper," IMF Policy Paper, June (Washington: International Monetary Fund). http://www.imf.org/external/np/pp/eng/2013/061013c.pdf

Kuttner, Kenneth N. and Ilhyock Shim, 2013, "Can non-interest rate policies stabilise housing markets? Evidence from a panel of 57 economies," BIS Working Papers No 433.

Lim, C.F. Columba, A. Costa, P. Kongsamut, A. Otani, M. Saiyid, T. Wezel, and X. Wu, 2011, "Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Experiences," IMF Working Paper 11/238 (Washington: International Monetary Fund).

Ostry, Jonathan David, Atish R. Ghosh,, Karl Friedrich Habermeier, Luc Laeven, Marcos Chamon, Mahvash Saeed Qureshi, and Annamaria Kokenyne, 2011, "Managing Capital Inflows: What Tools to Use?" IMF Staff Discussion Note 11/06 (Washington: International Monetary Fund).

Schoenmaker, Dirk, and Peter J. Wierts, 2011, "Macroprudential Policy: The Need for a Coherent Policy Framework," DSF Policy Paper 13 (Amsterdam, The Netherlands: Duisenberg School of Finance).

Shin, Hyun Song, 2010, "Non-Core Liabilities Tax as a Tool for Prudential Regulation," mimeo, princeton.edu/~hsshin/www/NonCoreLiabilitiesTax.pdf.

———, 2013, "Adapting Macroprudential Approaches to Emerging and Developing Economies," In Otaviano Canuto and Swati R. Ghosh (eds.), *Dealing with the Challenges of Macro Financial Linkages in Emerging Markets*, World Bank, Washington, D.C. pp.17-55.

Vandenbussche, Jérôme, Ursula Vogel, and Enrica Detragiache, 2012, "Macroprudential Policies and Housing Prices—A New Database and Empirical Evidence for Central, Eastern, and Southeastern Europe," IMF Working Paper 12/303 (Washington: International Monetary Fund).

White, William R. 2006, "Procyclicality in the financial system: do we need a new macrofinancial stabilisation framework?," BIS Working Papers, no 193, January.

Table 1. The Macro-Prudential Toolkit

	Restrictions related to borrower, instrument, or activity	Restrictions on financial sector balance sheet (assets, liabilities)	Buffer based policies	Other	
				Taxation, levies	**Other (including institutional infrastructure)**
Expansionary phase	Time varying caps/limits/rules on: - DTI, LTI, LTV - margins, hair-cuts - lending to sectors - credit growth	Time varying caps/limits on: -mismatches (FX, interest rate) - reserve requirements	Countercyclical capital requirements, leverage restrictions, general (dynamic) provisioning	Levy/tax on specific assets and/or liabilities	- Accounting (e.g., varying rules on mark to market) -Changes to compensation, market discipline, governance
Contractionary phase: fire-sales, credit crunch	Adjustment to specific loan-loss provisioning, margins or hair-cuts (e.g., through the cycle, dynamic)	Liquidity limits (e.g., Net Stable Funding Ratio, Liquidity Coverage Ratio)	Countercyclical capital requirements, general (dynamic) provisioning	Levy/tax (e.g., on non-core liabilities)	-Standardized products -OTC vs. on exchange -Safety net (Central Bank/Treasury liquidity, fiscal support)
Contagion, or shock propagation from SIFIs or networks	Varying restrictions on asset composition, activities (e.g., Volcker, Vickers)	Institution- specific limits on (bilateral) financial exposures, other balance sheet measures	Capital surcharges linked to systemic risk	Tax/levy varying by externality (size, network)	- Institutional infrastructure (e.g., CCPs) - Resolution (e.g., living wills) - Varying information, disclosure

	Enhancing resilience
	Dampening the cycle
	Dispelling gestation of cycle

Table 2. Details on Use of Macro-Prudential Instruments by Country/Year

Measures	Characteristics	Country	Classification		Period
Aimed at Borrowers					
Loan-to-value caps (LTV)	Reduces vulnerability arising from highly geared borrowings	Brazil	Closed	Emerging	2000-2010
		Bulgaria	Closed	Emerging	2010
		Canada	Open	Advanced	2000-2010
		Chile	Open	Emerging	2000-2010
		China	Closed	Emerging	2000-2010
		Colombia	Closed	Emerging	2000-2010
		Croatia	Open	Emerging	2000-2010
		France	Open	Advanced	2000-2010
		Hong Kong	Open	Advanced	2000-2010
		Hungary	Open	Emerging	2010
		India	Closed	Emerging	2000-2010
		Italy	Open	Advanced	2000-2010
		South Korea	Closed	Emerging	2002-2010
		Malaysia	Closed	Emerging	2000-2010
		Mexico	Open	Emerging	2000-2010
		Norway	Open	Advanced	2010
		Philippines	Closed	Emerging	2000-2010
		Poland	Closed	Emerging	2000-2010
		Romania	Open	Emerging	2004-2007
		Singapore	Open	Advanced	2000-2010
		Spain	Open	Advanced	2000-2010
		Sweden	Open	Advanced	2010
		Thailand	Closed	Emerging	2003-2010
		Turkey	Closed	Emerging	2010
Debt-to-income caps (DTI)	Reduces vulnerability arising from highly geared borrowings	China	Closed	Emerging	2000-2010
		Colombia	Closed	Emerging	2000-2010
		Hong Kong	Open	Advanced	2005-2010
		Poland	Closed	Emerging	2010
		Romania	Open	Emerging	2004-2008
		Serbia	Open	Emerging	2010
		South Korea	Closed	Emerging	2006-2010
Aimed at Financial Institutions (Adressing Asset Side)					
Credit growth caps (CG)	Reduces credit growth directly	China	Closed	Emerging	2000-2010
		Colombia	Closed	Emerging	2000-2010
		Malaysia	Closed	Emerging	2000-2010
		Nigeria	Closed	Emerging	2010
		Serbia	Open	Emerging	2008-2010
		Singapore	Open	Advanced	2010
Foreign currency lending limits (FC)	Reduces vulnerability to fx risks; Reduces credit growth directly	Argentina	Closed	Emerging	2003-2010
		Austria	Open	Advanced	2008-2010
		Brazil	Closed	Emerging	2000-2010
		Hungary	Open	Emerging	2010
		Poland	Closed	Emerging	2006-2010
		Romania	Open	Emerging	2005-2010
		Serbia	Open	Emerging	2008-2010
		Turkey	Closed	Emerging	2009-2010

* The classification variable divides the sample into emerging versus advanced economy countries (source: IMF), and open versus closed capital account countries (source: Chinn-Ito Index 2008). A country is defined as an open capital account country if its Chinn-Ito index is larger than the global median in 2005, and a closed capital account country if its Chinn-Ito index is smaller than the global median in 2005.

Table 2. Details on Use of Macro-Prudential Instruments by Country/Year (Continued)

Measures	Characteristics	Country	Classification		Period
Aimed at Financial Institutions (Adressing Liabilities Side)					
Reserve requirements (RR)	Reduces vulnerability to funding risks; Reduces credit growth indirectly	Brazil	Closed	Emerging	2008-2010
		Bulgaria	Closed	Emerging	2007-2010
		China	Closed	Emerging	2004-2010
		Colombia	Closed	Emerging	2007-2010
		Russia	Closed	Emerging	2004-2009
Aimed at Financial Institutions (Adressing Bank Buffers)					
Dynamic loan-loss provisioning (DP)	Increases resilience and reduces credit growth indirectly;	Brazil	Closed	Emerging	2005-2010
		Bulgaria	Closed	Emerging	2005-2010
		Colombia	Closed	Emerging	2007-2010
		India	Closed	Emerging	2010
		Mongolia	Open	Emerging	2010
		Peru	Open	Emerging	2008-2010
		Russia	Closed	Emerging	2010
		Spain	Open	Advanced	2000-2010
		Uruguay	Open	Emerging	2001-2010
Countercyclical capital requirements (CTC)	Increases resilience and reduces credit growth indirectly;	Brazil	Closed	Emerging	2007-2010
		India	Closed	Emerging	2008-2010
Profit distribution restrictions (PDR)	Limit dividend payments in good times to help build up capital buffers in bad times	Argentina	Closed	Emerging	2010
		Colombia	Closed	Emerging	2008-2010
		Poland	Closed	Emerging	2009-2010
		Romania	Open	Emerging	2009-2010
		Slovakia	Open	Emerging	2008-2010
		Turkey	Closed	Emerging	2008-2010
Other					
Other measures (countercyclical provisioning, countercyclical capital, restrictions on profit distribution, restrictions on treatment of profits in regulatory capital)	Decrease leverage growth	Brazil	Closed	Emerging	2007-2010
		Colombia	Closed	Emerging	2000-2010
		Croatia	Open	Emerging	2007-2010
		Hungary	Open	Emerging	2010
		Indonesia	Open	Emerging	2005-2010
		Malaysia	Closed	Emerging	2000-2010
		Norway	Open	Advanced	2010
		Serbia	Open	Emerging	2008-2010
		Slovakia	Open	Emerging	2008-2010
		South Africa	Closed	Emerging	2008-2010
		South Korea	Closed	Emerging	2008-2010
		Thailand	Closed	Emerging	2008-2010
		Uruguay	Open	Emerging	2008-2010

'* The classification variable divides the sample into emerging versus advanced economy countries (source: IMF), and open versus closed capital account countries (source: Chinn-Ito Index 2008). A country is defined as an open capital account country if its Chinn-Ito index is larger than the global median in 2005, and a closed capital account country if its Chinn-Ito index is smaller than the global median in 2005.

Table 3. Overall Use of Macro-Prudential Instruments

Type of Instrument	Group	Total Countries	Frequency of Use	Emerging Markets	Advanced Countries	Closed Capital	Open Capital Account	Frequency of EMs-year	Frequency of ACs-year
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Loan-to-Value Cap (LTV)	1	24	44%	15	9	11	13	35%	74%
Debt-to-Income Ratio (DTI)	1	7	9%	5	2	4	3	8%	11%
Credit Growth Caps (CG)	2	6	8%	5	1	4	2	10%	1%
Limits on Foreign Lending (FC)	2	8	8%	7	1	4	4	10%	3%
Reserve Requirements (RR)	2	5	5%	5	0	5	0	7%	0%
Dynamic Provisioning (DP)	3	9	9%	8	1	5	4	9%	11%
Counter-cyclical Requirements (CTC)	3	2	1%	2	0	2	0	2%	0%
Profit Redistribution (PR)	3	6	3%	6	0	4	2	4%	0%
Other MaPP	4	13	12%	12	1	6	7	15%	1%
Total by classification		35 (only)	100%	25 (only)	10 (only)	15 (only)	20 (only)	100%	100%

There are in total 35 countries using a macro-prudential policy at any point during the period 2000-2010. Countries are classified into emerging versus advanced economy countries (source: IMF), and open versus closed capital account countries (source: Chinn-Ito Index 2008). A country is defined as an open capital account country if its Chinn-Ito Index is larger than the global mean in 2005, and a closed capital account country if its Chinn-Ito Index is smaller than the global mean in 2005. The frequency of use is the ratio of country-pairs using a particular instrument to the total number of country-year pairs using a macroprudential policy (e.g. 44% of the time during 2000-2010, countries were using LTV ratios compared to only 9% of the time using DTI ceilings).

Table 4A. Summary Statistics of Regression Variables

Variable		ALL SAMPLE					AC					EM				
		Obs.	Mean	Std. Dev.	Min	Max	Obs.	Mean	Std. Dev.	Min	Max	Obs.	Mean	Std. Dev.	Min	Max
Banks		2821 (unique)					1609 (unique)					1212 (unique)				
Years		2000-2010					2000-2010					2000-2010				
Countries		48 (unique)					23 (unique)					25 (unique)				
Bank Level	Leverage Growth (YoY) (%)	18082	0.26	42.88	-385.62	385.62	10304	-0.41	36.33	-385.62	385.62	7778	1.13	50.25	-385.62	385.62
	Asset Growth (YoY) (%)	18092	13.32	28.40	-37.55	77.05	10314	10.34	25.51	-37.55	77.05	7778	17.28	31.39	-37.55	77.05
	Non-core to Core Liab. Growth (YoY)	15630	-1.16	56.48	-607.65	593.34	8783	-1.24	48.86	-607.65	593.34	6847	-1.05	64.96	-398.34	588.14
	Leverage Ratio	21225	13.55	10.55	0.84	39.70	12033	16.59	11.35	0.84	39.70	9192	9.58	7.79	0.84	39.70
	Loan to Deposit Ratio	18167	1.47	1.56	0.15	6.36	10139	1.60	1.61	0.15	6.36	8028	1.32	1.47	0.15	6.36
	Assets (USD $M)	21234	58030.4	211517.1	0.01	3914824	12042	89426.4	262293.9	0.01	3807892	9192	16899.9	101203.7	0.03	3914824
Country Level	Real GDP Growth (%)	28210	3.08	3.10	-3.31	9.52	16090	1.79	2.26	-3.31	9.52	12120	4.79	3.23	-3.31	9.52
	Interest Rate Change	22777	5.34	17.42	-25.80	43.51	11431	5.85	17.02	-25.80	43.51	11346	4.83	17.80	-25.80	43.51
	Exchange Rate Classification	31030	2.29	1.09	1	6	17699	2.16	1.19	1	4	13331	2.46	0.91	1	6
	MaPP subgroup1	31031	0.42	0.49	0	1	17699	0.30	0.46	0	1	13332	0.58	0.49	0	1
	LTV	31031	0.36	0.43	0	1	17699	0.27	0.42	0	1	13332	0.48	0.42	0	1
	DYI	31031	0.03	0.12	0	0.5	17699	0.01	0.06	0	0.5	13332	0.06	0.15	0	0.5
	MaPP subgroup2	31031	0.18	0.38	0	1	17699	0.02	0.14	0	1	13332	0.39	0.49	0	1
	CG	31031	0.08	0.27	0	1	17699	0.00	0.06	0	1	13332	0.18	0.39	0	1
	FC	31031	0.08	0.27	0	1	17699	0.02	0.13	0	1	13332	0.16	0.36	0	1
	RR	31031	0.06	0.23	0	1	17699	0.00	0.00	0	0	13332	0.13	0.34	0	1
	MaPP subgroup3	31031	0.10	0.30	0	1	17699	0.07	0.25	0	1	13332	0.15	0.35	0	1
	DP	31031	0.08	0.27	0	1	17699	0.06	0.24	0	1	13332	0.10	0.30	0	1
	CTC	31031	0.02	0.15	0	1	17699	0.00	0.00	0	0	13332	0.05	0.22	0	1
	PRD	31031	0.02	0.13	0	1	17699	0.00	0.06	0	1	13332	0.03	0.18	0	1
	Other	31031	0.09	0.28	0	1	17699	0.01	0.09	0	1	13332	0.19	0.39	0	1

Table 4B. Summary Statistics of Banking Variables by Country

Country	Number of Banks	Country Classification		Number of Observations	Use of MaPP 2000-2010	Leverage	Assets	NCC	Leverage	Assets	NCC	Leverage	Assets	NCC
						2000-2010			Expansionary Phase			Contractionary Phase		
Argentina	59	Closed	Emerging	649	Yes	0.73	9.13	-5.97	9.34	17.81	-6.27	-13.89	-5.57	-5.45
Australia	53	Open	Advanced	583	No	-3.37	11.88	4.53	-3.37	11.88	4.53			
Austria	100	Open	Advanced	1100	Yes	-0.18	11.57	-0.76	-0.47	13.71	-0.59	1.91	-3.53	-1.93
Belgium	67	Open	Advanced	737	No	-2.99	9.08	2.69	-2.56	10.00	4.04	-3.76	7.48	0.45
Brazil	100	Closed	Emerging	1100	Yes	3.25	22.20	0.07	3.25	19.36	3.07	3.27	29.50	-7.70
Bulgaria	27	Closed	Emerging	297	Yes	5.43	24.38	-1.66	8.69	31.95	-0.41	-3.04	4.67	-5.10
Canada	86	Open	Advanced	946	Yes	-2.02	12.33	-3.27	-1.96	17.86	-2.94	-2.19	-2.72	-4.16
Chile	27	Open	Emerging	297	Yes	1.47	16.26	-19.19	7.48	11.88	-18.21	-9.63	24.35	-20.90
China	100	Closed	Emerging	1100	Yes	-0.54	25.29	-2.78	-0.54	25.29	-2.78			
Colombia	28	Closed	Emerging	308	Yes	-2.28	13.26	1.07	-2.28	13.26	1.07			
Croatia	36	Open	Emerging	396	Yes	2.92	15.04	-1.48	3.35	16.21	-1.98	-0.11	6.78	2.21
Czech Republic	34	Open	Advanced	374	No	-1.21	16.50	-5.82	0.59	16.26	-2.40	-6.07	17.16	-15.16
Finland	22	Open	Advanced	242	No	3.13	10.99	1.26	3.13	10.99	1.26			
France	100	Open	Advanced	1100	Yes	-0.44	12.27	1.13	-0.22	13.22	2.62	-1.24	8.75	-4.62
Germany	100	Open	Advanced	1100	No	-0.81	7.20	-6.27	1.02	13.16	-6.66	-1.95	3.48	-6.04
Hong Kong	49	Open	Advanced	539	Yes	-1.06	9.51	-1.72	-1.06	9.51	-1.72			
Hungary	28	Open	Emerging	308	Yes	1.10	14.78	2.93	1.14	15.28	4.54	0.81	11.17	-8.10
India	91	Closed	Emerging	1001	Yes	-1.73	15.76	-1.06	-1.73	15.76	-1.06			
Indonesia	51	Open	Emerging	561	Yes	-3.02	16.93	-2.71	-3.12	14.04	-4.37	-2.21	41.38	11.86
Ireland	38	Open	Advanced	418	No	-2.09	4.29	0.77	5.31	12.58	-0.34	-17.08	-12.53	3.15
Italy	100	Open	Advanced	1100	Yes	0.85	10.28	-0.95	0.85	10.28	-0.95			
Japan	100	Open	Advanced	1100	No	-1.37	4.10	-0.38	-2.88	6.91	-4.47	-0.68	2.84	1.47
Malaysia	81	Closed	Emerging	891	Yes	1.65	11.88	3.25	2.23	10.39	7.45	-0.04	16.22	-9.23
Mexico	73	Open	Emerging	803	Yes	3.70	16.09	6.56	-0.35	13.56	-4.66	11.96	21.26	28.08
Mongolia	6	Open	Emerging	66	Yes	4.34	33.61	-1.12	2.08	34.09	3.48	22.86	29.68	-38.80
Netherlands	57	Open	Advanced	627	No	-3.05	7.96	-2.55	-2.20	10.54	-3.20	-6.66	-3.04	0.03
New Zealand	17	Open	Advanced	187	No	-1.07	3.97	-2.25	-1.00	9.48	-1.80	-1.25	-9.52	-3.37
Nigeria	28	Closed	Emerging	308	Yes	-8.42	17.49	-7.50	-12.43	19.18	-8.23	13.58	8.27	-3.03
Norway	100	Open	Advanced	1100	Yes	5.24	14.40	5.55	5.24	14.40	5.55			
Peru	25	Open	Emerging	275	Yes	-0.45	16.57	-4.55	4.03	18.31	2.07	-4.15	15.14	-9.66
Philippines	39	Closed	Emerging	429	Yes	4.75	16.45	-7.82	4.15	16.66	-8.62	9.89	14.59	-0.94
Poland	46	Closed	Emerging	506	Yes	2.74	14.78	-7.39	2.74	14.78	-7.39			
Portugal	39	Open	Advanced	429	No	0.75	11.50	7.65	0.83	11.26	8.56	-2.64	22.80	-29.55
Romania	27	Open	Emerging	297	Yes	7.15	20.40	4.30	10.66	27.75	9.39	-3.22	-1.36	-11.30
Russia	100	Closed	Emerging	1100	Yes	4.39	26.11	-0.68	4.39	26.11	-0.68			
Serbia	33	Open	Emerging	363	Yes	3.39	21.35	9.27	5.00	20.58	10.17	-15.31	30.23	-1.04
Singapore	29	Open	Advanced	319	Yes	1.30	12.36	-1.01	1.25	12.67	-0.72	1.98	7.90	-4.51
Slovak Republic	18	Open	Advanced	198	Yes	5.40	14.20	-0.82	3.49	13.32	10.90	14.79	18.54	-57.64
South Africa	49	Closed	Emerging	539	Yes	-1.15	12.13	-3.37	-2.31	12.10	-4.64	0.67	12.18	-1.32
South Korea	42	Closed	Emerging	462	Yes	1.39	14.52	-3.30	0.13	14.26	-3.14	3.82	15.04	-3.57
Spain	100	Open	Advanced	1100	Yes	0.72	8.38	6.60	0.72	8.38	6.60			
Sweden	100	Open	Advanced	1100	Yes	0.58	13.31	-4.52	0.58	13.31	-4.52			
Switzerland	100	Open	Advanced	1100	No	-0.11	12.04	-6.74	-0.67	9.59	-4.88	1.34	18.24	-11.45
Thailand	34	Closed	Emerging	374	Yes	-0.32	12.20	5.88	0.34	10.94	4.11	-3.45	18.22	13.70
Turkey	59	Closed	Emerging	649	Yes	-0.85	14.07	-2.76	0.49	15.48	0.50	-42.12	-29.51	-81.83
United Kingdom	100	Open	Advanced	1100	No	0.83	10.04	0.44	3.60	14.20	4.05	-4.56	2.01	-6.22
United States	100	Open	Advanced	1100	No	-2.40	10.17	-2.54	-2.58	8.98	-2.30	-1.67	14.95	-3.49
Uruguay	23	Open	Emerging	253	Yes	-3.64	7.44	-9.18	-4.63	4.14	4.79	-2.29	11.94	-27.81
Average (25 emerging countries)						1.04	17.13	-1.97	1.68	17.57	-0.87	-1.63	13.71	-9.00
Average (23 advanced countries)						-0.15	10.36	-0.39	0.33	11.85	0.46	-1.86	5.80	-8.94
Average (15 closed capital account countries)						0.60	16.64	-2.27	1.10	17.56	-1.80	-3.13	8.36	-10.45
Average (33 open capital account countries)						0.41	12.63	-0.73	1.01	13.59	0.48	-1.19	10.90	-8.40
Average (13 non-Mapp countries)						-1.06	9.21	-0.71	-0.06	11.22	-0.28	-4.09	5.81	-6.38
Average (35 Mapp countries)						1.04	15.62	-1.40	1.44	16.17	-0.22	-0.69	12.12	-10.11

Table 5. Base Regression Results of Effects of Macro-Prudential Policies: 2000-2010

	1	2	3	4	5	6
VARIABLES						
Lagged Asset Growth	-0.346***			-0.322***		-0.468**
	[0.051]			[0.106]		[0.221]
Lagged Real GDP Growth (%)	4.106***			7.705***		7.319
	[1.033]			[2.829]		[5.022]
Lagged Interest Rate Change	0.207**			0.186		0.019
	[0.090]			[0.123]		[0.229]
Exchange Rate Classification	-0.157			-1.160		-0.689
	[0.328]			[1.011]		[1.374]
Lagged Leverage Ratio	-0.022*			-0.029**		-0.024
	[0.012]			[0.015]		[0.020]
Lagged Loan to Deposit	0.125			0.212		0.348
	[0.105]			[0.166]		[0.410]
Subgroup1		-0.441***	-0.439***	0.449		
		[0.145]	[0.146]	[0.328]		
Sub1 X Lagged Asset Growth			0.108			
			[0.151]			
Subgroup2		-0.656***	-0.631***	-0.994***		
		[0.183]	[0.191]	[0.344]		
Sub2 X Lagged Asset Growth			-0.027			
			[0.083]			
Subgroup3		0.041	0.018	-0.206		
		[0.076]	[0.078]	[0.195]		
Sub3 X Lagged Asset Growth			-0.159			
			[0.109]			
Subgroup4		-0.673***	-0.732***	-0.717***		
		[0.105]	[0.112]	[0.138]		
Sub4 X Lagged Asset Growth			0.152			
			[0.125]			
LTV					-0.852***	0.794
					[0.225]	[1.158]
DTI					1.297	6.009*
					[1.126]	[3.128]
CG					-0.704**	-2.656*
					[0.346]	[1.532]
FC					-0.392	-2.335***
					[0.244]	[0.857]
RR					-0.067	-0.164
					[0.088]	[0.291]
DP					-0.126	0.512
					[0.160]	[0.516]
CTC					-0.406***	0.585
					[0.099]	[0.521]
PRD					0.108	-0.328
					[0.092]	[0.411]
Other					-0.673***	-1.443**
					[0.105]	[0.592]
Observations	13,804	8,527	8,527	8,527	8,527	8,527
Number of index number	2,630	1,667	1,667	1,667	1,667	1,667
Standard errors in brackets						

Notes: The dependent variable is bank total asset growth. We control for the first lag of asset growth (the dependent variable), and the lagged bank leverage and loan-to-deposit ratios. The macroprudential policy measures used are: 1. MaPP Aimed at Borrowers (caps on loan-to-value and caps on debt-to-income), 2. MaPP Aimed at Financial Institutions, Asset Side (limits on credit growth, limits on foreign lending), and Liabilities Side (reserve requirements); 3. MaPP Aimed at Financial Institutions as Buffers (dynamic provisioning, countercyclical provisioning and countercyclical capital, restrictions on profit distribution), and 4. Other. Although regressed one at a time, the four MaPPs are shown at the same time in columns (2), (3) and (5) to save space. The regressions in (4) and (6) include all MaPP variables simultaneously. These are all GMM regressions which use (4) lagged differences, the lagged real credit growth, and a time trend (fixed effect) as instrumental variables. The regressions control for individual trends (country-fixed effects). GMM standard errors are in brackets.

***, **, and * represent significance at the 1, 5, and 10 percent levels respectively.

Table 6. Effectiveness of Macro-Prudential Policies by Phase of the Cycle

	1	2	3	4
VARIABLES				
Lagged Asset Growth	-0.350***	-0.211**	-0.336***	-0.437***
	[0.072]	[0.092]	[0.071]	[0.074]
Lagged Real GDP Growth (%)	0.039	4.125***	3.247***	2.469**
	[1.713]	[1.194]	[1.188]	[1.008]
Lagged Interest Rate Change	-0.254*	0.061	-0.289*	-0.074
	[0.140]	[0.212]	[0.167]	[0.149]
Exchange Rate Classification	-3.295**	-3.273**	-3.232**	-2.482***
	[1.506]	[1.471]	[1.488]	[0.863]
Lagged Leverage Ratio	0.015	-0.010	0.013	-0.010
	[0.013]	[0.015]	[0.012]	[0.012]
Lagged Loan to Deposit	-0.072	-0.069	0.004	0.056
	[0.114]	[0.117]	[0.112]	[0.104]
Downswing	-0.230***	-0.141***	-0.203***	-0.122**
	[0.059]	[0.054]	[0.049]	[0.049]
Subgroup1	-0.353*			
	[0.200]			
Sub1 X downswing	0.237*			
	[0.121]			
Subgroup2		-0.609***		
		[0.179]		
Sub2 X downswing		0.103		
		[0.089]		
Subgroup3			0.059	
			[0.078]	
Sub3 X downswing			0.021	
			[0.127]	
Subgroup4				-0.537***
				[0.100]
Sub4 X downswing				0.188
				[0.134]
Observations	8,290	8,290	8,290	8,290
Number of index_number	1,637	1,637	1,637	1,637
Standard errors in brackets				

Notes: The dependent variable is bank total asset growth. We control for the first lag of asset growth (the dependent variable), and the lagged bank leverage and loan-to-deposit ratios. The macroprudential policy measures used are: 1. MaPP Aimed at Borrowers (caps on loan-to-value and caps on debt-to-income), 2. MaPP Aimed at Financial Institutions, Asset Side (limits on credit growth, limits on foreign lending), and Liabilities Side (reserve requirements); 3. MaPP Aimed at Financial Institutions as Buffers (dynamic provisioning, countercyclical provisioning and countercyclical capital, restrictions on profit distribution), and 4. Other. These are all GMM regressions which use (4) lagged differences, the lagged real credit growth, and a time trend (fixed effect) as instrumental variables. The regressions control for individual trends (country-fixed effects). GMM standard errors are in brackets.
***, **, and * represent significance at the 1, 5, and 10 percent levels respectively.

Table 7. Emerging Markets vs. Advanced Countries

	1	2	3
VARIABLES			
Lagged Asset Growth		-0.307**	
		[0.127]	
Lagged Real GDP Growth (%)		15.989***	
		[5.156]	
Lagged Interest Rate Change		0.282*	
		[0.159]	
Exchange Rate Classification		-0.545	
		[1.225]	
Lagged Leverage Ratio		-0.008	
		[0.019]	
Lagged Loan to Deposit		0.311	
		[0.197]	
Subgroup1	-1.274***	-2.473	-1.762***
	[0.379]	[1.508]	[0.518]
Sub1 X Emerging	1.286**	3.622**	1.657***
	[0.501]	[1.690]	[0.634]
Sub1 X Lagged Asset Growth			1.175**
			[0.549]
Sub1 X Lagged Asset Growth * Emerging			-2.178**
			[0.912]
Subgroup2	0.466	1.201	-5.257
	[1.499]	[2.487]	[3.610]
Sub2 X Emerging	-1.226	-2.359	4.293
	[1.589]	[2.499]	[3.650]
Sub2 X Lagged Asset Growth			17.629
			[12.305]
Sub2 X Lagged Asset Growth * Emerging			-17.388
			[12.304]
Subgroup2	0.099	0.001	0.457
	[0.544]	[0.293]	[0.798]
Sub3 X Emerging	-0.058		-0.500
	[0.540]		[0.798]
Sub3 X Lagged Asset Growth			-2.370*
			[1.374]
Sub3 X Lagged Asset Growth Emerging			2.196*
			[1.283]
Subgroup4	-1.008***	1.306	-0.950**
	[0.337]	[1.213]	[0.431]
Sub4 X Emerging	0.380	-2.018*	0.291
	[0.355]	[1.193]	[0.421]
Sub4 X Lagged Asset Growth			-0.490
			[1.149]
Sub4 X Lagged Asset Growth *Emerging			0.640
			[1.032]
Observations	8,527	8,527	8,527
Number of index number	1,667	1,667	1,667

Notes: The dependent variable is bank total asset growth. We control for the first lag of asset growth (the dependent variable), and the lagged bank leverage and loan-to-deposit ratios. The macroprudential policy measures used are: 1. MaPP Aimed at Borrowers (caps on loan-to-value and caps on debt-to-income), 2. MaPP Aimed at Financial Institutions, Asset Side (limits on credit growth, limits on foreign lending), and Liabilities Side (reserve requirements); 3. MaPP Aimed at Financial Institutions as Buffers (dynamic provisioning, countercyclical provisioning and countercyclical capital, restrictions on profit distribution), and 4. Other. Although regressed one at a time, the four MaPPs are shownat the same time in one column in (1) and (3) to save space. The regression in (2) includes all MaPP variables simultaneously. These are all GMM regressions which use (4) lagged differences, the lagged real credit growth, and a time trend (fixed effect) as instrumental variables. The regressions control for individual trends (country-fixed effects). GMM standard errors are in brackets.

***, **, and * represent significance at the 1, 5, and 10 percent levels respectively.

Figure 1. Channels Through Which Banks can Become Vulnerable

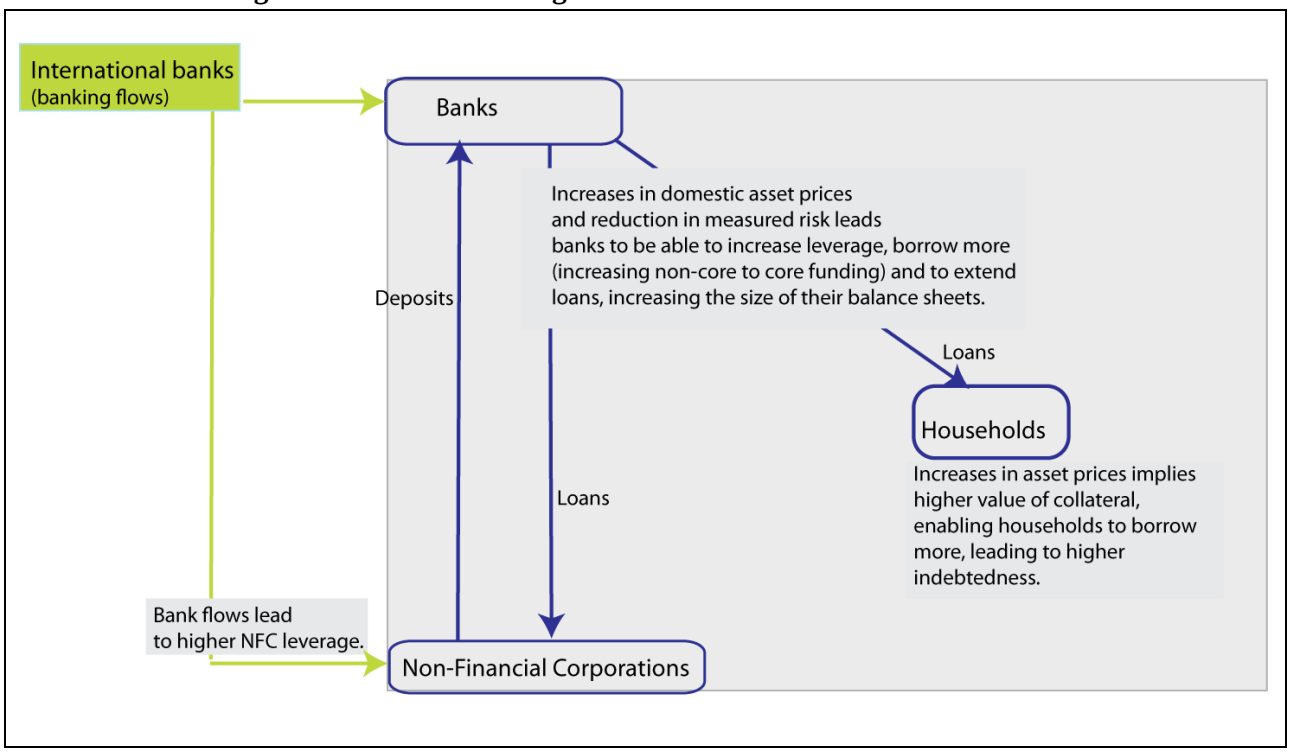
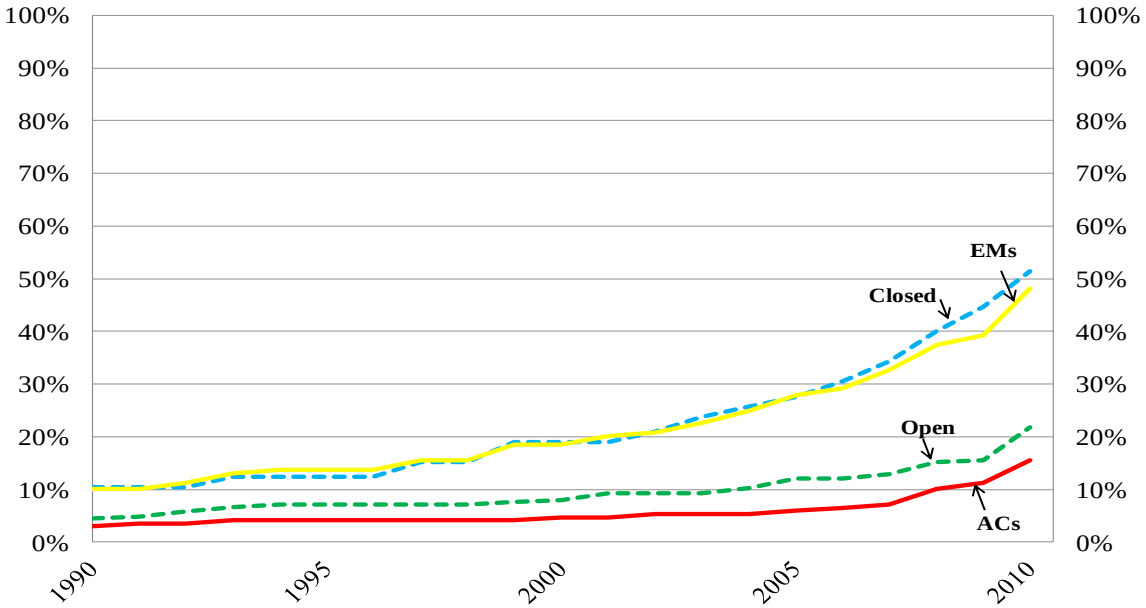


Figure 2. Use of Macro-Prudential Policies: Advanced Countries vs. Emerging Markets and Open vs. Closed Capital Account*



* Index of MaPP usage in emerging markets (EMs), advanced countries (ACs), open capital account economies (Open) and closed capital account economies (Closed). The index represents the percentage of countries in our sample that have used macro-prudential policies. Sources: Lim et al. (2011); Fund staff calculations.