Policies for Macrofinancial Stability:

Dealing with Credit Booms and Busts

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I. INTRODUCTION

"Credit booms" – episodes of rapid credit growth – pose a policy dilemma. More credit means increased access to finance and greater support for investment and economic growth (Levine, 2005). But when expansion is too fast, such booms may lead to vulnerabilities through looser lending standards, excessive leverage, and asset price bubbles. Indeed, credit booms have been associated with financial crises (Reinhart and Rogoff, 2009). Historically, only a minority of booms has ended in crashes, but some of these crashes have been spectacular, contributing to the notion that credit booms are at best dangerous and at worst a recipe for disaster (Gourinchas, Valdes, and Landerretche, 2001; Borio and Lowe, 2002; Enoch and Ötker-Robe, 2007).

These dangers notwithstanding, until the recent global financial crisis the policy debate paid limited attention to credit booms, especially in advanced economies.[2] This might have reflected two issues. First, with the diffusion of inflation targeting, monetary policy had increasingly focused on interest rates and had come largely to disregard monetary aggregates.[3] And regulatory policy, with its focus on individual institutions, was ill-equipped to deal with aggregate credit

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[2] In a few emerging markets, however, credit booms were an important part of the policy discussions, and warnings on possible risks were put out prior to the crisis. See, for instance, Backé, Égert, and Zumer (2005), Boissay, Calvo-Gonzales, and Kozluk (2006), Cottarelli, Dell'Ariccia, and Vladkova-Hollar (2003), Duenwald, Gueorguiev, and Schaechter (2005), Hilbers and others (2005), and Terrones (2004).

[3] Of course, there were exceptions, such as the "two-pillar" policy of the ECB and the more credit-responsive approach of central banks in India and Poland.

dynamics.[4] Second, as for asset price bubbles, there was the long-standing view that it was better to deal with the bust than to try to prevent the boom, because unhealthy booms were difficult to separate from healthy ones, and in any event, policy was well equipped to contain the effects of a bust.

The crisis, preceded by booms in many of the harder-hit countries, has challenged that view. In its aftermath, calls for more effective tools to monitor and control credit dynamics have come from several quarters (see, for instance, FSA, 2009). And the regulatory framework has already started to respond. For instance, Basel III introduced a capital buffer range that is adjusted "when there are signs that credit has grown to excessive levels" (Basel Committee on Banking Supervision, 2010).

Yet, while a consensus is emerging that credit booms are too dangerous to be left alone, there is little agreement on what the appropriate policy response should be. First, there is the issue of whether and when to intervene. After all, not all booms end up in crises, and the macro costs of curtailing credit can be substantial. Second, should intervention be deemed necessary, there are questions about what form such intervention should take. Is this a natural job for monetary policy, or are there concerns that favor other options? This paper addresses both of these issues by exploring several questions about past credit booms and busts: What triggers credit booms? When do credit booms end up in busts, and when do they not? Can we tell in advance those that will end up badly? What is the role of different policies in curbing credit growth and/or mitigating the associated risks?

This discussion note proceeds as follows. Section II presents some stylized facts on the characteristics of credit booms. Section III discusses the triggers of credit booms. Section IV analyzes the characteristics of booms that end up in busts or crises. Section V discusses the policy options and their effectiveness in dealing with credit booms. Section VI concludes.

II. Credit Booms: Definition and Characteristics

Two caveats before we start. First, in this paper, we limit our attention to bank credit. Obviously, there are other sources of credit in the economy (bond markets, nonbank financial intermediaries, trade credit, informal finance, and so on). But data availability makes a cross-country analysis of these alternative sources difficult, and with a few exceptions (notably the United States), bank credit accounts for an overwhelming share of total credit. Hence, we are confident that we are capturing the vast majority of macro-relevant episodes. Second, for similar reasons, we confine our attention to countries with credit-to-GDP ratios above 10 percent. Unfortunately, this automatically excludes the vast majority of low-income countries. However, given these countries' different institutional and structural characteristics, an analysis of their credit dynamics is better conducted in a separate paper.

[4] Again, there were exceptions, like the Bank of Spain's dynamic provisioning, the loan eligibility requirements of the Hong Kong Monetary Authority, and the multipronged approach of the Croatian National Bank.

We are interested in episodes that can be characterized as "extraordinary" positive deviations in the relationship between credit and economic activity. Admittedly, what constitutes an extraordinary deviation and how the "normal" level of credit growth should be computed are both open to interpretation (Gourinchas, Valdes, and Landerretche, 2001; Mendoza and Terrones, 2008; Barajas, Dell'Ariccia, and Levchenko, 2008; Jordà, Schularick, and Taylor, 2011; Claessens, Kose, and Terrones, 2012; Mitra and others, 2011). Most methodologies in the literature compare a country's credit-to-GDP ratio to its nonlinear trend (some focus on absolute growth thresholds). But the methodologies differ in several respects, such as whether the trend and the thresholds identifying the booms should be country-specific, whether information unavailable at the time of the boom should be used for its identification, and whether the credit and GDP series should be filtered separately or directly as a ratio. Luckily, the set of booms identified using different methods is rather robust.

Our aim in this paper is to provide a definition that can be applied using the standard information that is available and therefore can be used as a guide in policymaking. For that reason, we opt for feasibility first and accept the cost of ignoring information that exists today but was not available to policymakers in real time. This contrasts with methodologies that use the entire time series to detect deviations from trend (for example, Mendoza and Terrones, 2008). We also apply a mix of country-specific, path-dependent thresholds and absolute numerical thresholds. This is because thresholds for the credit-to-GDP gap are often hard to determine or interpret (and have been shown to miss many of the episodes associated with financial crises; Mitra and others, 2011). In contrast, absolute thresholds for credit growth are easier to interpret, but abstract from country- and time-specific characteristics. Overall, our methodology allows us to account for differences across countries as well as changes over time within the same country, and it avoids the risk of missing episodes due to an over-fitting trend. (More details on our approach, its pros and cons, and comparison to other methodologies are in the Annex.)

Specifically, we identify boom episodes by comparing the credit-to-GDP ratio in each year t and country i to a backward-looking, rolling, country-specific, cubic trend estimated over the period between years $t-10$ and t. We classify an episode as a boom if either of the following two conditions is satisfied: (i) the deviation from trend is greater than 1.5 times its standard deviation and the annual growth rate of the credit-to-GDP ratio exceeds 10 percent; or (ii) the annual growth rate of the credit-to-GDP ratio exceeds 20 percent. We introduce the second condition to capture episodes in which aggregate credit accelerates very gradually but credit growth reaches levels that are well above those previously observed in the country. Similar thresholds identify the beginning and end of each episode. Since only information on GDP and bank credit to the private sector available at time t is used, this definition can, in principle, be made operational.

We apply this definition to a sample of 170 countries with data starting as far back as the 1960s and extending to 2010. We identify 175 credit boom episodes.[5] This translates into a 14 percent

[5] Following similar practice in the literature, we drop cases in which the credit-to-GDP ratio is less than 10 percent. The reason for this is twofold. First, financial deepening is more likely to be the main driver of rapid credit expansion episodes in such financially underdeveloped economies. Second, the data series tend to be less smooth, making it difficult to distinguish between trend-growth and abnormal growth episodes.

probability of a country experiencing a credit boom in a given year.[6] Based on this sample, the stylized facts that characterize credit booms are as follows:

- The median boom lasts three years, with the credit-to-GDP ratio growing at about 13 percent per year, or about five times its median growth in non-boom years (Figure 1).

- Credit booms are not a recent phenomenon. But the fraction of countries experiencing a credit boom in any given year has seen an upward trend since the financial liberalization and deregulation of the 1980s. It reached an all-time high (30 percent in 2006; see Figure 2) in the run-up to the global financial crisis when a combination of factors – such as the financial reform associated with EU accession in Europe and the expansion of securitization in the United States – provided further support for credit growth.

- Most booms happen in middle-income countries. This is consistent with the view that, at least in part, credit booms are associated with catching-up effects. Yet high-income countries are not immune to booms, suggesting that other factors are also at play.

- More booms happen in relatively undeveloped financial systems. The median credit-to-GDP ratio at the start of a boom is 19 percent, compared to a median credit-to-GDP ratio of about 30 percent for the entire dataset. This supports the notion that booms can play a role in financial deepening.

- Geographically, booms are more likely to be observed in Sub-Saharan Africa and Latin America. This partially reflects these regions' country composition and historically volatile macroeconomic dynamics. Eastern Europe stands out in the later period, reflecting the expansion of the EU and the associated integration and catching up that fueled booms in many of the new or prospective member states. Of course, this summarizes past experience, and inferences on the probability of future booms should be drawn with caution.

A. Macroeconomic Performance around Credit Booms

Real economic activity and aggregate credit fluctuations are closely linked through wealth effects and the financial accelerator mechanism (see, among others, Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997; Gilchrist and Zakrajsek, 2008). In an upturn, better growth prospects improve borrower creditworthiness and collateral values. Lenders respond with an increased supply of credit and, sometimes, looser lending standards. More abundant credit allows for greater investment and consumption and further increases collateral values. In a downturn, the process is reversed.

Not surprisingly, economic activity is significantly higher during booms compared to non-boom years (Table 1). Real GDP growth during booms exceeds the rate observed in non-boom years by

[6] This probability is calculated by dividing the number of country-year observations that correspond to a credit boom episode by the number of non-missing observations in the dataset.

roughly 2 percentage points, on average.[7] Private consumption expands faster during booms. But it is private investment that picks up markedly, with the average growth rate more than doubling compared to non-boom years. This is in line with the important role played by banks in financing real-estate and corporate investment in many countries, but it also reflects, at least in part, the role played by capital inflows in the form of foreign direct investment.[8]

The increase in consumption and investment associated with credit booms is often more pronounced in the nontradables sector. Consistently, booms are typically associated with real exchange rate appreciations (Terrones, 2004). Interestingly, inflation remains subdued (more on this later). Taken together, these findings suggest that domestic imbalances that may be building up vent through the external sector. Indeed, during a boom the current account deteriorates, on average, by slightly more than 1 percentage point of GDP per year. Most of the associated increase in net foreign liabilities comes from the "other flows" category, which includes banks' funding by foreign sources.

Since asset price cycles tend to co-move with business and credit cycles (Claessens, Kose, and Terrones, 2012; and Igan and others, 2011), the comparison between non-boom years and booms carries over to these indicators. Both stock and real estate prices surge during credit booms and lose traction at the end of a boom. The difference from non-boom years is more striking than in the case of GDP components: equity prices rise at almost quadruple the rate in real terms. House prices, on average, grow at an annual rate of around 2 percent in non-boom years but accelerate sharply during booms to a growth rate of 10 percent. This synchronization with asset price booms may create balance sheet vulnerabilities for the financial and nonfinancial sectors, with repercussions for the broader economy.

B. Long-Run Consequences of Credit Booms

Credit booms can also be linked to macroeconomic performance over the long run. After all, financial development—typically measured by the credit-to-GDP ratio, the same variable used to detect credit booms—has a positive effect on growth (King and Levine, 1993; Rajan and Zingales, 1998; Levine, Loayza, and Beck, 1999; Favara, 2003).[9] Moreover, the economic magnitude of this effect is substantial: increasing financial depth (measured by M2-to-GDP ratio) from 20 percent to 60 percent would increase output growth by 1 percent a year (Terrones, 2004).

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[7] Note that non-boom years include (asset price and/or credit) busts and recessions. The comparative statistics, however, remain broadly the same when the bust and recession years are excluded.

[8] See Mendoza and Terrones (2008), Igan and Pinheiro (2011), and Mitra and others (2011) for more on the behavior of macroeconomic variables and some micro-level analysis around credit booms. At the macro level, there is evidence of a systematic relationship between credit booms and economic expansion, rising asset prices, leverage, foreign liabilities of the private sector, real exchange rate appreciation, widening external deficits, and managed exchange rates. At the micro level, there is a strong association between credit booms and firm-level measures of leverage, market value, and external financing, and bank-level indicators of banking fragility.

[9] This causal interpretation is supported by its differential impact across sectors: financial development affects economic growth more for sectors with external financing needs for investment (Rajan and Zingales, 1998).

Obviously, whether episodes that sharply increase the credit-to-GDP ratio have long-term beneficial effects depends on two factors. The first is the extent to which credit booms contribute to permanent financial deepening. The second is the extent to which financial deepening acquired through a sharp increase in credit resembles, in "quality," deepening achieved through gradual growth.

As for the first question, booms are sometimes followed by financial crises (see next section) that are typically associated with sharp drops in the credit-to-GDP ratio. However, in about 40 percent of the episodes, the credit-to-GDP ratio seems to shift permanently to a new, higher "equilibrium" level. In fact, there is a positive correlation between long-term financial deepening (measured as the change in the credit-to-GDP ratio over the period 1970-2010) and the cumulated credit growth that occurred during boom episodes (Figure 3).

The second question can be answered only indirectly, by looking at the relationship between credit booms and long-term growth. This task is complicated, because growth benefits gained from increased financial deepening due to a boom are likely to take time to be fully realized, making it hard to measure them at a given point in time. That said, some evidence does point to such benefits. There is a positive correlation between the number of years a country has undergone a credit boom and the cumulative real GDP per capita growth achieved since 1970 (Table 2). However, this relationship seems to flatten when credit booms become too frequent, and since countries with more credit booms also experienced more crises (on average), there seems to be a trade-off between macroeconomic performance and stability (Rancière, Tornell, and Westermann, 2008).

C. Credit Booms and Financial Crises

Balancing the benefits described earlier is the notion that credit booms are dangerous because they lead to financial crises. This is not just an underserved bad reputation due to a small fraction of episodes that were particularly bad. Credit growth can be a powerful predictor of financial crises (Borio and Lowe, 2002; Mendoza and Terrones, 2008; Schularick and Taylor, 2009; Mitra and others, 2011). In our sample, about one in three booms is followed by a banking crisis (as defined in Laeven and Valencia, 2010; and Caprio and others, 2005) within three years of its end (Table 3).[10]

The recent global financial crisis has reinforced this notion. After all, the crisis had its roots in a rapid increase of mortgage loans in the United States. And it was exactly the regions that had experienced greater booms during the expansion that suffered greater increases in credit delinquency during the crisis (Figure 4; also see Dell'Ariccia, Igan, and Laeven, 2008). In

[10] This is not very sensitive to the choice of methodology and thresholds used in identifying boom episodes. There is a slight tendency for methodologies based on a trend calculated over the whole sample to overestimate the probability of a credit boom ending badly, since the trend is then affected by the years that follow the boom. See the Annex for a comparison of the good and bad booms identified here and those identified elsewhere in the literature. Actually, the baseline used here is the smallest when the percentage of booms followed by a banking crisis is compared across different methodologies used to identify booms.

addition, across countries, many of the hardest-hit economies, such as Iceland, Ireland, Latvia, Spain, and Ukraine, had their own home-grown credit booms (Claessens and others, 2010).

Credit booms had also preceded many of the largest banking crises of the past 30 years: Chile (1982), Denmark, Finland, Norway, and Sweden (1990/91), Mexico (1994), and Korea, Malaysia, Philippines, and Thailand (1997/98) (Figure 5). And going further back, the Great Depression was also cast as a credit boom gone wrong (Eichengreen and Mitchener, 2003).[11]

The fact that several credit booms that did not end in full-blown crises were followed by extended periods of subpar economic performance adds further concern. In our sample, three out of five booms were characterized by below-trend growth during the six-year period following their end. During these below-trend periods, annual economic growth was on average 2.2 percentage points lower than in "normal" times (excluding crises). Notably, the two types of events--financial crisis and suppressed economic activity--often coincide but do not perfectly overlap. Overall, in the aftermath of credit booms something "goes wrong" about two times out of three (121 out of 175 cases). In line with this, in the recent global financial crisis, countries that had previously experienced bigger changes in their credit-to-GDP ratio were also the ones that had deeper recessions (Figure 6).[12] This is consistent with the view that credit booms leave large sectors of the economy overleveraged, leading to impaired financial intermediation in their aftermath, even when a full-blown crisis is avoided.

Indeed, credit booms are a good predictor of "creditless recoveries," that is, economic recoveries that happen in the absence of credit growth (typically in the aftermath of a crisis). Such recoveries are inferior, with average growth about a third lower than during normal recoveries (Abiad, Dell'Ariccia, and Li, 2011). Industries that are dependent on external finance and financing-sensitive activities (for example, investment) appear to suffer more during creditless recoveries, potentially indicating that resources may be allocated inefficiently across industries and activities.

III. What Triggers Credit Booms?

So far, we have summarized how credit booms are linked to short- and long-term economic performance and how often they coincide with financial crises. But macroeconomic and financial factors, including policies, may themselves contribute to the occurrence of credit booms. Hence, we next look at the other side of the coin: the triggers of credit booms. Identifying these triggers could help gauge a country's susceptibility to credit booms and devise policies to reduce this susceptibility.

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[11] Credit booms are generally associated with banking crises rather than other types of crises. For comparison, 15 percent of the booms in the sample were followed by a currency crisis and 8 percent by a sovereign debt crisis. Although some of these same countries also had systemic banking crises, the positive association remains when these cases are excluded. And although some of these credit booms coincided with housing booms, the association is robust to excluding those cases (Crowe and others, 2011; Leigh and others, 2012).

[12] The extraordinary experience of the Baltic countries and Ireland may seem to be driving this finding. But this correlation, albeit weaker, holds for the rest of the episodes as well.

Three often concurrently observed factors are frequently associated with the onset of credit booms (see, for instance, Mendoza and Terrones, 2008; Decressin and Terrones, 2011; and Magud, Reinhart, and Vesperoni, 2012):

- The first factor is financial reforms. These usually aim to foster financial deepening and are linked to sharp increases in credit aggregates. Roughly a third of booms follow or coincide with financial liberalizations. In contrast, only 2 percent follow or coincide with a reversal of such policies. Given that our sample contains more liberalization episodes than reversals, these percentages are less divergent when expressed in relative terms, but still point in the same direction: 18 percent of liberalizations are linked to credit booms, compared with 7 percent of reversals.

- The second factor is surges in capital inflows, often in the aftermath of capital account liberalizations. These generally lead to a significant increase in the funds available to banks, potentially relaxing credit constraints. In our sample, net capital inflows intensify during the three-year period prior to the start of a credit boom, increasing from 2.3 percent of GDP to 3.1 percent of GDP, on average.

- Third, credit booms generally start during or after buoyant economic growth.[13] More formally, lagged GDP growth is positively associated with the probability of a credit boom: in the three-year period preceding a boom, the average real GDP growth rate reaches 5.1 percent, compared to 3.4 percent in an average tranquil three-year period.

These triggers may occur across countries simultaneously. Financial liberalization happens in waves, affecting multiple countries more or less at the same time. In emerging markets, surges in capital flows often relate to changes in global liquidity conditions (as proxied by the U.S. federal funds rate[14]; see Figure 2) and, thus, are correlated across countries. The transmission of technological advances across borders synchronizes economic activity.

Of course, domestic factors may also matter. The differential incidence of booms across countries suggests that local structural and institutional characteristics and policies are important. In particular, credit booms seem to occur more often in countries with fixed exchange rate regimes, expansionary macroeconomic policies, and low quality of banking supervision (Table 4). In economies with fixed exchange rate regimes, monetary policy is directed toward maintaining a fixed exchange rate and is therefore unable to respond effectively to the buildup of a credit boom. In such regimes, a lower global interest rate may translate into a lower domestic interest rate, spurring domestic credit growth. By stimulating aggregate demand, expansionary macroeconomic policies risk building up asset price booms. Loose monetary policy, in

[13] From a longer-term perspective, technological groundbreakers and their diffusion are also likely to act as triggers. For instance, the ratio of bank loans to GDP on a "global" scale increased relatively fast during the last third of the 19th century and then again starting in the early 1980s with the introduction of new financial products, thanks to the information technology revolution (Schularick and Taylor, 2009).

[14] See Borio, McCauley, and McGuire (2011) on the role of global conditions in the context of credit booms.

particular, reduces the cost of borrowing and boosts asset price valuations, which in turn can trigger credit booms (however, see evidence in Section V.A). Finally, the quality of banking supervision has a bearing on the enforcement of bank regulation and the effectiveness with which supervisory discretion is applied to deal with early signs of credit booms. For example, supervisors can use their discretion to take measures (such as higher capital requirements) to lower the pace of credit growth.

That said, it is difficult to predict credit booms. Regression analysis suggests that the triggers and macroeconomic conditions described above have some bearing on assessing the susceptibility of a country to a credit boom. But the residual variability is substantial and identifying causality is problematic (see the discussion of the results in Table 7 below).

IV. CAN WE TELL BAD FROM GOOD CREDIT BOOMS?

The analysis in the previous sections implies that policymaking may face a trade-off between standing in the way of financial deepening (and thus in the way of present and perhaps future macroeconomic performance) and allowing dangerous imbalances to jeopardize financial stability. The question then arises, whether we can improve on this trade-off by distinguishing, ahead of time, bad booms from good ones.

Here we address this question by exploring whether a boom's characteristics, such as duration, size, and macroeconomic conditions, can help predict whether it will turn into a crisis and/or a prolonged period of subpar economic performance. Formally, we classify a boom as "bad" if it is (i) followed by a banking crisis within three years of its end date, or (ii) associated with a recession or an inferior (below-trend) medium-term growth performance.[15]

First, we compare the summary statistics on the characteristics of bad booms to those for good booms. Second, we conduct a regression analysis. As in other similar exercises, there are limitations associated with cross-country regressions (see, for example, Levine and Renelt, 1992). In particular, there is a trade-off between sample size and the homogeneity of the countries covered. We mitigate this problem by controlling for various country characteristics.

Given that a boom is in place, the probability of its turning bad is modeled as:

$$(Bad\ boom = 1)_{it} = \alpha + \beta X_{it}{}' + \gamma P_{it}{}' + \varepsilon_{it}$$

where X is a vector of macroeconomic indicators and structural variables and P is a vector of measures of the policy stance *during* the boom. In summary, we find that:

[15] Subpar macroeconomic performance is defined in reference to the trend of log real GDP. Specifically, growth is deemed to be subpar if the current level of log real GDP is below its trend calculated using a moving-average filter over the past five years. Note that this may be overstating how bad macroeconomic performance is, since the trend calculations include the strong growth years during the boom, yet the findings are robust to using alternative definitions, e.g., comparisons of real GDP growth rate to its medium-term trend. Note that, in many cases, the criteria (i) and (ii) overlap: in 16 out of 57, or 28 percent, of the cases in which there is a crisis, growth stalls (see Table 3).

- "Bad" credit booms tend to be larger and last longer (Figure 7), and

- Booms that start at a higher level of financial depth (measured as the level of credit-to-GDP ratio) are more likely to end badly.

These findings are more or less in line with those reported elsewhere. For instance, the magnitude of a boom (manifested as a larger rise in the credit-to-GDP ratio from start to end or duration) has been identified as a predictor of whether the boom ends up in a banking crisis (Gourinchas, Valdes, and Landerretche, 2001; Barajas, Dell'Ariccia, and Levchenko, 2008). Other macro variables, like larger current account deficits, higher inflation, lower-quality bank supervision, and faster growing asset prices, are sometimes associated with bad booms. But their coefficients are rarely significant and they are unstable across subsamples and model specifications. In addition, while there is a general tendency to think that credit booms in emerging markets are more likely than booms elsewhere to end up in a crisis, we do not observe such regularity in our sample.[16]

In general, the lack of statistically significant differences in key macroeconomic variables in bad versus good booms has been noted elsewhere (see, for instance, Gourinchas, Valdes, and Landerretche, 2001). Notably, indicators that have been identified as predictors of financial crises, such as sharp asset price increases, a sustained worsening of the trade balance, and a marked increase in bank leverage (Mitra and others, 2011) lose significance once we condition for the presence of a credit boom (as measured in this note). Indeed, in our sample, while asset prices grow much faster during booms than in tranquil times (for example, for equity prices about 11 percent versus 4 percent a year), they grow at about the same pace during both bad and good booms (again, for equity prices, about 11 percent a year for both).

While statistical evidence to pin down ahead of time whether a boom is a good or bad one is underwhelming, the results suggest that policy intervention to curb credit growth become increasingly justified as booms become larger and more persistent. In particular, we find that close to half or more of the booms that either lasted longer than six years (4 out of 9), exceeded 25 percent of average annual growth (8 out of 18), or started at an initial credit-to-GDP ratio higher than 60 percent (15 out of 26) ended up in crises. These regularities (see also Mitra and others, 2011; and Borio, McCauley, and McGuire, 2011) can guide policymakers in weighing the benefits and costs of an ongoing boom and in setting thresholds that would trigger policy action.

V. POLICY OPTIONS

The evidence presented so far shows that credit booms can stimulate economic activity and even promote long-term growth, but also that they are associated with disruptive financial crises. Indeed, about one boom in three ends with a bust. More often, booms end without a full-blown

[16] In absolute terms, many of the booms ending in a banking crisis occurred in emerging markets (27 out of 57). Yet in relative terms, 38 percent of the booms happening in emerging markets are followed by a crisis within three years after the boom ends, while the ratio is 57 percent for advanced economies.

crisis, but their associated leverage build-ups have a long-lasting impact on corporate and household behavior, leading to below-trend economic growth.

Theory has identified several channels through which financial frictions can lead to excessive risk taking during episodes of rapid credit growth. Contributing to looser lending standards and greater credit cyclicality may be managerial reputational concerns (Rajan, 1994), improved borrowers' income prospects (Ruckes, 2004), loss of institutional memory of previous crises (Berger and Udell, 2004), expectations of government bailouts (Rancière, Tornell, and Westermann, 2008), and a decline in adverse selection costs due to improved information symmetry across banks (Dell'Ariccia and Marquez, 2006). In addition, externalities driven by strategic complementarities (such as cycles in collateral values) may lead banks to take excessive or correlated risks during the upswing of a financial cycle (De Nicolò, Favara, and Ratnovski, 2012). Such financial frictions can explain why, as the old banking maxim goes, "the worst loans are made at the best of times" and justify intervention to prevent excessive risk taking during the boom.

Some of these frictions and their associated risks were well known before the global financial crisis, yet policies paid limited attention to the problem (with notable exceptions in emerging markets). This limited attention reflected several factors.

First, with the adoption of inflation targeting regimes, monetary policy in most advanced economies and several emerging markets had increasingly focused on the policy rate and paid little attention to monetary aggregates. There were a few exceptions. Australia and Sweden adjusted their monetary policy in response to asset price and credit developments and communicated the reason explicitly in central bank statements. Other policies, such as the European Central Bank's (ECB's) "two-pillar" policy, were regarded as vestiges from the past and played a debatable role in actual policy setting).[17]

Second, bank regulation focused on individual institutions. It largely ignored the macroeconomic cycle and was ill-equipped to respond to aggregate credit dynamics. As for asset price bubbles, by and large a notion of benign neglect prevailed, namely that it was better to deal with the bust than try to prevent the boom. Again, there were exceptions. Spain introduced "dynamic provisioning." Bolivia, Colombia, Peru, and Uruguay adopted similar measures (Terrier and others, 2011). Other emerging markets experimented with applying prudential rules to counteract credit and asset-price cycles (Table 5). But these exceptions formed a minority. Moreover, the measures taken were often small in scale and therefore did not always have their desired effect.

Third, financial liberalization and increased cross-border banking activities limited the effectiveness of policy action. In countries with *de jure* or *de facto* fixed-exchange-rate regimes,

[17] The ECB has rejected the notion that it followed a strict money-growth targeting from the start (ECB, 1999). In December 2002, the policy strategy was revised to reduce the prominence of "the monetary analysis" by placing it as the second rather than the first pillar and using it mainly as a "cross-check" for the results from the first pillar ("the economic analysis"). Even then, the two-pillar strategy was criticized by many (Svensson, 2003; Woodford, 2008). And, in the eye of several observers, the role played by monetary aggregates in the ECB's policy has been debatable (Berger, de Haan, and Sturm, 2006).

capital flows hindered the impact of monetary policy on credit aggregates. And prudential measures were subject to regulatory arbitrage, especially in countries with developed financial markets and a widespread presence of foreign banks.

In what follows, we discuss the major policy options (monetary, fiscal, and macroprudential tools) to deal with credit booms, with particular attention to their pros and cons, summarized in Table 6, in the light of the experiences of various countries and econometric analysis. We examine what policies, if any, have been successful in stopping or curbing episodes of fast credit growth. But we also investigate whether certain policies have been effective in reducing the dangers associated with booms, even if they did not succeed in stopping them. In that regard, we look at the coefficients of the policy variables obtained in the econometric analysis specification described in the previous section.

A. Monetary Policy

When it comes to containing credit growth, monetary policy seems the natural place to start. After all, M2, a common measure of the money supply, is highly correlated with aggregate credit. In principle, a tighter monetary policy stance increases the cost of borrowing throughout the economy, and lowers credit demand. Higher interest rates also reduce the ability to borrow through their impact on asset prices, and thus on collateral values, via the credit channel (Bernanke and Gertler, 1995). Finally, higher interest rates tend to reduce the growth of market-based financial intermediaries' balance sheets (Adrian and Shin, 2009) as well as leverage and bank risk taking (Borio and Zhu, 2008; De Nicolò and others, 2010).

However, several factors may limit the effectiveness of monetary policy in preventing or stopping credit booms, or in ensuring good booms do not turn into bad ones. First, there may be a conflict of objectives. True, credit booms can be associated with general macro overheating. In that case, higher policy rates are the obvious answer. But they can also occur under seemingly tranquil macroeconomic conditions, as was the case in several countries in the run-up to the financial crisis (Figure 8). Under those conditions, the monetary stance necessary to contain the boom may differ substantially from that consistent with the inflation target (such conflicts are likely to be even stronger when the boom is concentrated in a single or a few sectors, for example, real estate loans). In addition, since tightening will buy lower (unobservable) risk at the cost of a higher (observable) unemployment rate, it will likely run into strong social and political opposition, making the decision to raise policy rates harder.

A second tension may arise if crucial elements of the private sector (banks, corporates, and households) have weakened balance sheets. An increase in interest rates to tame credit growth with the objective of safeguarding future financial stability would have the side effect of increasing the present debt burden and lowering asset prices. If the debt-service obligations are already at or near capacity, this would threaten balance sheet stability (similar to the threat discussed in the debate on whether central banks should be in charge of bank supervision).

Third, complications can arise when capital accounts are open and "the impossible trinity" comes into play. Countries with a fixed exchange rate regime simply do not have the option to use monetary policy. Others that float are seriously concerned about large exchange rate swings associated with carry trade when monetary policy is tightened. In addition, unless intervention

can be fully sterilized, capital inflows attracted as a result of higher interest rates can undo the effects of a tighter stance. Moreover, credit funded by capital inflows brings additional dangers, including an increased vulnerability to a sudden stop.

Fourth, monetary tightening may fail to stop a boom and instead contribute to the risks associated with credit expansion. For instance, higher cost for loans denominated in domestic currency may encourage borrowers and lenders to substitute them with foreign-currency loans. Alternatively, to make loans more affordable, shorter-term rates, teaser contracts, and interest-only loans may come to dominate new loan originations. This is especially relevant when there are explicit or implicit government guarantees that protect the banking system, or when there are widespread expectations of public bailouts should the currency depreciate sharply (Rancière, Tornell, and Westermann, 2008).

In line with these concerns, the empirical evidence that tighter monetary policy conditions (measured as deviations from a simple Taylor-rule-like equation) are linked to a lower frequency of credit booms is mixed at best.[18] The coefficient on monetary tightening is unstable and rarely significant, suggesting that on average monetary policy is not very effective in dealing with booms, either by reducing their incidence (Table 7) or by reducing the probability that a boom already in place would end up badly (Table 8). A tighter stance may help slow down a boom, that is, it may be negatively linked to the speed of the boom, measured as the average annual rate of growth in the credit-to-GDP ratio (regression results available upon request). But it does not seem to slow the boom enough to contain the associated risks.[19] Partly in contrast, a growing literature suggests that easy monetary policy conditions are conducive to lower lending standards, which in turn could lead to credit booms (see Maddaloni and Peydró, 2011, and references therein).

These regressions may underestimate the effectiveness of monetary policy due to an endogeneity problem. Should central banks tighten the policy rate in reaction to credit booms, on average higher rates would coincide with faster credit growth. Put differently, positive deviations from conditions consistent with a Taylor rule would stem from the credit booms themselves. This would tend to reduce the size and significance of the regression coefficients, that is, it would bias the results against monetary policy effectiveness.

Country cases lend very limited support to the notion that monetary policy can effectively deal with a credit boom. During the last decade, many central and eastern European countries tightened monetary policy to contain inflation pressures, but these had little tangible effect on credit growth. In some cases, this reflected high euroization and ineffective monetary transmission channels. In others, increased capital inflows reversed the intended effects. Where the tightening seemed to have some short-lived impact on containing the boom (for example,

[18] Related evidence shows that credit booms happen more often in environments of high real lending rates. Moreover, such booms are more likely to be followed by problems in the banking sector.

[19] The lack of statistical evidence in support of monetary policy is in line with the findings in Merrouche and Nier (2010) for a sample of advanced countries ahead of the global financial crisis. By contrast, they find the strength of prudential policies was important in containing these booms.

Hungary and Poland), shifts to foreign-currency-denominated lending were observed (Brzoza-Brzezina, Chmielewski, and Niedźwiedzińska, 2010).

That said, countries that allowed their exchange rates to appreciate more freely (for example, Poland, Czech Republic, and Slovakia) did experience smaller credit booms. And in many advanced countries, the mortgage credit and house price booms recorded prior to the global financial crisis can be linked to lax monetary conditions (for example, Crowe and others, 2011, and references therein). However, there is an emerging consensus that the degree of tightening that would have been necessary to have a meaningful impact on credit growth would have been substantial and would have entailed significant costs for GDP growth.

Summarizing, monetary policy is in principle the natural framework for intervention to contain a credit boom. In practice, however, there are constraints that limit its action. From the evidence above, we expect monetary policy to be more effective in larger and more closed economies, where capital inflows and currency substitution are less of a concern. The benefits of monetary tightening will be more evident and its costs lower when credit booms occur in the context of general macro overheating. In contrast, the increase in interest rates necessary to stem booms associated with sectoral bubbles (such as those in real estate) may entail substantial costs—especially since, during these episodes, expected returns vastly overwhelm the effect of marginal changes in the policy rate.

Against this background, macroprudential measures and international policy coordination can improve the effectiveness of monetary policy. For instance, macroprudential policies targeted at net open foreign exchange positions may contain currency substitution, and cooperation with home supervisors of foreign banks may help reduce cross-border lending.

B. Fiscal Policy

Both cyclical and structural elements of the fiscal policy framework may play a role in curbing credit market developments. Most importantly, engaging in a prudent stance and conducting fiscal policy in a countercyclical fashion may help reduce overheating pressures associated with a credit boom. On the structural side, removing provisions in the tax code that create incentives for borrowing may reduce long-term leverage.

More critically, fiscal consolidation during the boom years can help create room for intervention to support the financial sector or stimulate the economy if and when the bust arrives. Based on the average gross fiscal cost of banking crises, estimates suggest that a buffer of 5 percent of GDP over the life of the boom would be actuarially fair (the number would drop to about 3 percent of GDP if based on net costs).[20]

[20] The average gross fiscal cost of systemic banking crises is estimated to be about 15 percent of GDP (Laeven and Valencia, 2010). Multiplying this with the probability of a banking crisis following a credit boom (33 percent) gives 5 percent. This buffer comes on top of the margins one would normally associate with prudent fiscal policy over the cycle and may not be enough to leave room for fiscal stimulus in the case of a recession.

From a practical point of view, however, traditional fiscal tools are unlikely to be effective in taming booms. As in the case of macroeconomic cycle management, their significant time lags prevent a timely response. Political economy factors may also play an important role, with election cycles introducing additional oscillations. And in the long run, the removal of incentives for borrowing in the tax code is unlikely to have a cyclical effect on credit growth.

Empirical evidence supports these considerations. Fiscal tightening is not associated with a reduced incidence of credit booms (Table 7), nor a lower probability of a boom ending badly (Table 8).[21] A review of country experiences attests to the one-off effect from the removal of tax incentives to take on debt (for example, the 2002 introduction of limits on mortgage interest deductibility in Estonia). And, recent experience in Central and Eastern Europe suggests that fiscal policy contributed to credit growth.

New fiscal tools have been proposed in the aftermath of the global financial crisis. These could take the form of levies imposed on financial activities – measured by the sum of profits and remuneration (Claessens, Keen, and Pazarbasioglu, 2010) – or a countercyclical tax on debt aiming to reduce leverage and mitigate the credit cycle (Jeanne and Korinek, 2010). These would go directly to the heart of the problem: the externalities associated with leverage and risk taking. Such "financial activities taxes" or "taxes linked to credit growth" could put downward pressure on the speed of individual financial institutions' expanding, preventing them from becoming "too systemically important to fail." The revenues could be used to create a *public* buffer rather than private buffers for individual institutions (as capital requirements do). Moreover, unlike prudential regulation that applies only to banks, the proposed tools could contain credit expansion by nonbank financial institutions as well.

However, there are practical difficulties with the newly proposed fiscal tools as well. Incentives to evade the new levies may lead to an increase in the resources devoted to "tax planning." These incentives may actually strengthen when systemic risk is elevated because, as the possibility of having to use the buffers increases, financial institutions may attempt to avoid "transfers" to others through the public buffer. A further complication may arise if there are provisions to protect access to finance by certain borrowers or access to certain types of loans: circumvention through piggy-back loans or by splitting liabilities among related entities may generate a worse situation for resolution if the bust comes. In addition, in order for these new measures to be effective, they would have to take into account how banks will react to their imposition. This would likely mean a diversified treatment for different categories of banks (which opens up the risk of regulatory arbitrage) and progressive rates based on information similar to what is used for risk-weighted capital requirements (see Keen and de Mooij, 2012).

In summary, while fiscal policy is important to tame the overheating in the economy and create room to provide stimulus and financial support if and when the bust comes, its effectiveness in

[21] Actually, the regression results suggest that fiscal tightening is positively related to the incidence of booms, perhaps reflecting the unexpectedly high tax revenues with buoyant economic growth in the background during the boom years or the possibility that fiscal policy is tightened in response to the credit boom in place.

directly dealing with credit booms may be limited. The newer proposals advocating "financial taxation" make sense on paper, but remain to be tested.

C. Macroprudential Regulation

So far, the empirical analysis and the case studies seem to suggest that the effectiveness of macroeconomic policies in curbing credit booms is questionable. One reason for this discouraging message could be the high potential costs imposed on economic activity by these far-reaching and relatively blunt policies. A more targeted approach can, in principle, be more effective and reduce the costs associated with policy intervention, although this obviously is not true if one espouses the view that monetary aggregates (and therefore credit) are the major determinant of inflation pressures. Macroprudential policies offer such a targeted approach. Moreover, the externalities that exist between financial institutions and that contribute to the accumulation of vulnerabilities during the boom or amplify the negative shocks during the bust provide a rationale for macroprudential regulation.

Macroprudential policies are policies aimed at limiting systemwide risks in the financial system. In a strict sense, they include prudential tools and regulation to address externalities in the financial system (BIS, 2011; and IMF, 2011a). In a broader sense, however, the objective of macroprudential policies is to smooth financial and credit cycles in order to prevent systemic crises and provide cushion against their adverse effects. For our purposes, the broader interpretation is relevant. From this perspective, the most commonly used macroprudential tools can be grouped into the following three categories[22]:

- *Capital and liquidity requirements*: These measures affect the cost and/or composition of the liabilities of financial institutions by increasing their capital and liquidity buffers. For instance, countercyclical capital requirements increase the cost of bank capital, and thus lending, in good times. Dynamic loan-loss provisioning rules, which build up capital buffers in the form of reserves in good times to absorb losses during bad times, also fall into this category. Capital and liquidity requirements can be countercyclical to smooth the credit cycle and/or include surcharges for systemically important financial institutions to limit the build-up of systemic risk.

- *Asset concentration and credit growth limits*: These measures alter the composition of the assets of financial institutions by imposing limits on the pace of credit growth or on their asset concentration. Examples include speed limits on credit expansion, limits on foreign currency exposure or foreign-currency-denominated lending, and limits on sectoral concentration of loan portfolios. The aim of these measures is to reduce the exposure of bank portfolios to sectoral shocks and, to the extent that slower credit growth improves average loan quality, to aggregate shocks.

- *Loan eligibility criteria*: These measures limit the pool of borrowers that have access to finance to improve the average quality of borrowers. Examples include loan-to-value

[22] Note that tools from different categories can be combined to address specific sources of systemic risk.

(LTV) and debt-to-income (DTI) limits. These limits seek to leave the "marginal" borrowers out of the pool. LTVs also safeguard lenders by increasing loan collateral. Eligibility criteria can be tailored to fit a loan portfolio's risk profile. For example, LTV limits can be linked to local house price dynamics or be differentiated based on whether loans are made in foreign currency to unhedged households or not.

Several obstacles make the econometric analysis of the impact of macroprudential policy on credit booms difficult. First, there are serious data availability and measurement issues. Macroprudential policy frameworks have not been around for a long time, and a mere handful of countries have used them regularly. Second, macroprudential policy is often implemented in combination with changes in the macroeconomic stance and involves multiple instruments in the same package. Therefore, attributing specific outcomes to specific instruments is a difficult task. Third, in most cases, policies are implemented in reaction to credit market developments. Hence, endogeneity is a major problem, and we must underline that our analysis does not attempt to establish causality. That said, endogeneity would result in positive coefficients: more credit growth leads to macroprudential tightening. Thus, a significant negative correlation between the use of macroprudential tools and credit booms would suggest that these policies are effective in alleviating the boom.

We construct an aggregate measure of macroprudential policy that includes the sum of the following six measures: differential treatment of deposit accounts, reserve requirements, liquidity requirements, interest rate controls, credit controls, and open foreign exchange position limits.[23] We compile information on these measures from various issues of the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions* and complement this with information from IMF Article IV reports and responses of country authorities to an IMF questionnaire (see IMF, 2011b).[24] The identified measures have been used more intensely over time since the mid-90s (Figure 9). Reserve and liquidity requirements, followed by limits on open foreign exchange positions, have been used most frequently.

This exercise brings some promising results, suggesting that macroprudential tools can reduce the incidence of credit booms and decrease the probability that booms end up badly (Tables 7 and 8).[25] Consistent with the focus of macroprudential tools on financial sector vulnerabilities, the reduction in the probability of a bad boom is found primarily for booms that end up in a financial crisis, although the effect on the probability of economic underperformance is not very different. This suggests that macroprudential policy can reduce the risk of a bust while

[23] Ideally, we would like to use a variable that indicates the macroprudential policy stance throughout the duration of the boom. While we are able to do that with the monetary and fiscal policy variables, there is not enough variation for measuring macroprudential policy in the same way.

[24] Note that, especially in the early years of the sample period, the use of such measures may not reflect macroprudential concerns as they came to be defined in the aftermath of the global financial crisis (for such a definition of macroprudential policy, see BIS, 2011, and IMF, 2011a).

[25] When estimating regressions using the subcomponents of the macroprudential index, we find that credit and interest controls and open foreign exchange position limits enter significantly in most regressions, although their significance is sensitive to the specific combination of variables included.

simultaneously reducing the vulnerability of the rest of the economy to troubles in the financial system.[26] These findings are in line with those in Lim and others (2011), who suggest that macroprudential tools, such as LTV and DTI caps, ceilings on credit growth, reserve requirements, and dynamic provisioning rules, can mitigate the "procyclicality" of credit.

This empirical evidence fits with the experience of countries that have used macroprudential policy tools. In general, these tools have been found to perform better in avoiding bad outcomes following credit booms rather than in preventing them altogether. Country experience with the most common macroprudential tools can be summarized as follows:

- *Capital and liquidity requirements*: These measures have been broadly successful in building up buffers to deal with busts. But they have been less successful in curtailing the incidence and duration of credit booms. Tight capital and reserve requirements in Croatia are viewed as having been effective in increasing the banks' liquidity and capital buffers. This helped banks weather the global financial crisis, but was less effective in slowing credit growth and capital inflows (Kraft and Galac, 2011; Ostry and others, 2011). Likewise, Peru's reserve requirements on deposits in 2008 helped contain the risks posed by rapid credit growth while shielding the inflation targeting framework (Terrier and others, 2011). Dynamic loan-loss provisioning rules introduced in Spain in 2000 allowed Spanish banks to better absorb the negative shocks and maintain exposures during the crisis. In this way, they worked in their intended countercyclical fashion (Jiménez and others, 2011). Yet they did not stop the boom, and reliance on historical series to determine their magnitude may have made the buffers too small for what turned out to be an exceptional boom-bust cycle. In an interesting case targeting a specific class of assets, Brazil raised the risk weight on high-LTV car loans in December 2010, to restrain the rapid growth in this segment. Preliminary data suggest that this move has had its intended effect of raising interest rates on car loans and slowing down the supply of such credit.

- *Asset concentration and credit growth limits*: These measures have had some success in slowing down the pace of credit, although often at the expense of building up concentrations of risk elsewhere in the system. For example, while credit growth in Romania remained strong despite a wave of measures, strict foreign exchange exposure limits introduced between September 2005 and January 2007 managed to curb foreign-currency-denominated loan growth. In Croatia, speed limits on credit growth by banks were introduced in 2003 (limiting the annual growth of banks' domestic credits to 16 percent), combined with a penalty in the form of minimum holdings of central bank's bills, if credit growth exceeded this limit. These had some success in reducing the growth rate of bank credit (which fell from 28.7 percent in 2002 to 11.8 percent in 2003), since the penalty for breaching the rule was high. However, the growth of total domestic credit (including credit from nonbanks) barely declined, as banks circumvented the rule by booking loans directly on their foreign parent banks and by lending to the private sector

[26] We interact the macroprudential policy measure with the macroeconomic policy variables to control for any complementarities or conflicts between these policies. We obtain no significant results.

through their nonbank (for example, leasing company) subsidiaries (Kraft and Galac, 2011). This contributed to the build-up of systemic risk in the nonbank financial sector.

- *Loan eligibility criteria*: Experience using these measures is limited, but when implemented they seem to have been effective in curbing the deterioration in lending standards typically associated with credit booms (Dell'Ariccia, Igan, and Laeven, 2008). For example, the resilience of the banking system in Hong Kong during the Asian financial crisis in 1998 has been attributed to the introduction of actively managed LTV and DTI restrictions (Wong and others, 2011). Similarly, in Korea, LTV and DTI limits seem to have discouraged speculation in housing markets (Igan and Kang, 2011). In Poland, loan eligibility requirements on foreign-currency-denominated mortgage loans were credited for keeping default rates low during the global financial crisis – this in spite of the zloty's significant depreciation against the currencies (euro and Swiss franc) in which these loans were denominated.

As a whole, macroprudential tools show some promise in dealing with credit booms and busts (see also Lim and others, 2011, based on the experience of 49 countries since 2000). However, more time and analysis are needed for a full assessment of their effectiveness. Their targeted nature entails a more favorable cost-benefit balance. Yet a potential problem with their targeted nature is that it makes these instruments more susceptible to circumvention and political resistance. Circumvention may end up masking or increasing systemic risks by shifting credit activity into less-regulated intermediaries or to riskier loan types. And these distortions may prove economically important, similar to those documented for credit controls (Kane, 1977; Borio, 2003 and 2009).

Since the losers and winners of a particular macroprudential measure are more clear-cut than in the case of macroeconomic policies, it might be easier to gather and organize public opposition to the implementation of certain measures. There is then a tension between a rule-based approach to the application of these measures, to minimize political interference, and a discretionary approach that could better deal with circumvention. As with monetary tightening, cross-border policy coordination could help avoid circumvention and enhance the potential effectiveness of macroprudential policies. For example, the incentives to shift lending to foreign bank branches or less-regulated financial institutions may be reduced when communication and coordinated action among supervisors are strong.

VI. CONCLUSIONS

Prolonged credit booms are a harbinger of financial crises and have real costs. Our analysis shows that, while only a minority of booms end up in crises, those that do can have long-lasting and devastating real effects if left unaddressed. Yet it appears to be difficult to identify bad booms as they emerge, and the cost of intervening too early and running the risk of stopping a good boom therefore has to be weighed against the desire to prevent financial crises.

While the analysis offers some insights into the origins and dynamics of credit booms, from a policy perspective a number of questions remain unaddressed. In part this reflects the limited experience to date with macroprudential policies and the simultaneous use of multiple policy tools, making it hard to disentangle specific policy measures' effectiveness.

First, while monetary policy tightening seems the natural response to rapid credit growth, we find only weak empirical evidence that it contains booms and their fallout on the economy. This may be partly the result of a statistical bias. But there are several "legitimate" factors that limit the use and effectiveness of monetary policy in dealing with credit booms, especially in small open economies. In contrast, there is more consistent evidence that macroprudential policy is up to this task, although it is more exposed to circumvention.

All of the above raise important questions about the optimal policy response to credit booms. Our view is that when credit booms coincide with periods of general overheating in the economy, monetary policy should act first and foremost. If the boom lasts and is likely to end up badly or if it occurs in the absence of overheating, then macroprudential policy should come into play. Preferably, this should be in combination and coordination with macroeconomic policy, especially when macroeconomic policy is already being used to address overheating of the economy.

Second, questions remain about the optimal mix and modality of macroprudential policies, also in light of political economy considerations and the type of supervisory arrangements in the country. Political economy considerations call for a more rules-based approach to setting macroprudential policy to avoid pressure from interest groups to relax regulation during a crisis. But such considerations have to be weighed against the practical problems and unintended effects of a rules-based approach, such as the calibration of rules with rather demanding data requirements and the risk of circumvention in the presence of active earnings management. The design of a macroprudential framework should also consider the capacity and ability of supervisors to enforce such rules so that unintended and potentially dangerous side effects can be avoided.

Third, the optimal macroprudential policy response to credit booms, as well as the optimal policy mix, will likely have to depend on the type of credit boom. Because of data limitations, our analysis has focused on aggregate credit. While it seems natural that policy response should adapt to and be targeted to the type of credit, additional analysis is needed to assess the effectiveness of policies to curtail booms that differ in the type of credit.

Fourth, policy coordination, across different authorities and across borders, may increase the effectiveness of monetary tightening and macroprudential policies. Cooperation and a continuous flow of information among national supervisors, especially regarding the activities of institutions that are active across borders, are crucial. Equally important is the coordination of regulations and actions among supervisors of different types of financial institutions. Whether and how national policymakers take into account the effects of their actions on the financial and macroeconomic stability of other countries is a vital issue, calling for further regional and global cooperation in the setup of macroprudential policy frameworks and the conduct of macroeconomic policies.

ANNEX. TECHNICAL DEFINITION OF A CREDIT BOOM

We focus our attention on "extraordinary" deviations in the relationship between credit and economic activity. In this context, we define a "credit boom" as an episode in which the ratio of credit to GDP grows faster than what is implied by its trend, which follows the normal pace of credit growth in that particular country. An episode of rapid credit growth is marked as a boom when the deviation from trend exceeds a country- and path-dependent or *ad hoc* threshold. To put it more specifically, credit-to-GDP ratio in each year *t* is compared to a country-specific, backward-looking, rolling cubic trend estimated over the period between years *t-10* and *t*. The cubic trend lets us introduce two inflection points so that both financial deepening and its reversal are allowed. An episode becomes a boom if either of the following two conditions is satisfied: (i) the deviation from trend is greater than 1.5 times its standard deviation and the annual growth rate of the credit-to-GDP ratio exceeds 10 percent; or (ii) the annual growth rate of the credit-to-GDP ratio exceeds 20 percent.

To capture the borderline cases, we also use a more *ad hoc* rule, which defines any period during which the annual growth rate of the credit-to-GDP ratio exceeds 10 percent as a boom. The start of the boom is the earliest year in which either (i) the credit-to-GDP ratio exceeds its trend by more than three-fourths of its historical standard deviation while its annual growth rate exceeds 5 percent; or (ii) its annual growth rate exceeds 10 percent.

A boom ends as soon as either (i) the growth of the credit-to-GDP ratio turns negative; or (ii) the credit-to-GDP ratio falls within three-fourths of one standard deviation from its trend and its annual growth rate is lower than 20 percent. Note that, since credit is a stock variable measured at year-end while GDP is a flow variable, the credit-to-GDP ratio is constructed with the geometric average of GDP in years *t* and *t+1*. We check the robustness of our definition by employing different thresholds and comparing the list of booms we obtain against the lists reported in previous studies. While the main insights remain the same, only the empirical findings using the baseline definition are discussed due to space constraints.

There are several advantages and drawbacks in using this methodology. On the positive side, the financial sector is not considered in isolation: by looking at the credit-to-GDP ratio rather than credit itself, the methodology relates credit developments to the size of the economy and accounts for the procyclicality of credit. In addition, only standard information about relevant past credit growth readily available in real time is used to set the benchmark, which is a particularly desirable feature for policymaking. On the negative side, the methodology may erroneously tag an observation as a credit boom when the credit-to-GDP ratio jumps up not because of an increase in credit but because of a decrease in GDP. We manually check such cases and drop them from the list of booms. Another potential drawback is that the aggregate measure used captures only *bank* credit to the private sector (line 22d from the IMF's *International Financial Statistics*). While nonbank financial institutions constitute a small portion of the financial system assets and provide a negligible amount of credit to the private sector in many countries, credit booms driven by nonbank provision of loans may be missed. The discrepancy between bank credit and total credit is larger in countries with market-based, rather than bank-based, financial systems. Two countries that particularly stand out in this regard are the United Kingdom and the United States. All in all, the methodology provides an operationally convenient way to detect credit booms in real time.

A natural question is how much the methodology used to define and identify the credit boom episodes alter the major empirical regularities underlined during the analysis. As mentioned at the beginning of Section II, there are various methodologies used in the literature. We compare our methodology to that in Gourinchas Valdes, and Landerretche (2001) and that in Mendoza and Terrones (2008). In addition, we check the identification of booms with these trend-based methodologies to an *ad hoc* rule which deems any growth in credit-to-GDP ratio above 20 percent as a boom. The correlation between the boom dummies created by these four methodologies is high (Table A1).[27] Hence, the list of episodes we identify is not very sensitive to the methodology used. In particular, the major booms (for example, those preceding the Scandinavian and Asian crises) are captured under all methodologies. The differences appear in small and medium-sized booms, since thresholds start binding.

Perhaps a more important concern is that, depending on which booms each methodology leaves out, the incidence of bad booms may be different. Indeed, in their original analysis, these methodologies arrive at different probabilities of booms that are linked to banking crises. Specifically, Gourinchas, Valdes, and Landerretche (2001) looks at 80 booms based on absolute and relative (to the credit-to-GDP ratio) deviation from trend – rather than setting the thresholds first, they limit the number of episodes. Using the criterion of calling a boom bad if it is followed by a crisis within three years from its end, 50 percent of absolute booms and 38 percent of relative booms they identify are bad. Mendoza and Terrones (2008) look at credit per capita instead of credit-to-GDP ratio and identify 58 episodes, with 47 percent ending badly. Since the differences may also be due to the sample periods and the data, we apply the methodologies used in these two papers to our dataset. The bad boom incidences reported in our baseline are actually on the lower end of the distribution (Table A2).

[27] Given that we are comparing binary variables constructed as "binned" realizations of an underlying continuous variable, we use a tetrachoric correlation.

REFERENCES

Abiad, Abdul, Giovanni Dell'Ariccia, and Bin (Grace) Li, 2011, "Creditless Recoveries," IMF Working Paper No. 11/58 (Washington, DC: International Monetary Fund).

Abiad, Abdul, Enrica Detragiache, and Thierry Tressel, 2008, "A New Database of Financial Reforms," IMF Working Paper No. 08/266 (Washington, DC: International Monetary Fund).

Adrian, Tobias, and Hyun Song Shin, 2009, "Money, Liquidity, and Monetary Policy," *American Economic Review*, Vol. 99, No. 2, pp. 600-05.

Backé, Peter, Balázs Égert, and Tina Zumer, 2005, "Credit Growth in Central and Eastern Europe: Emerging from Financial Repression to New (Over)Shooting Stars?" Unpublished manuscript, Austrian National Bank.

Barajas, Adolfo, Giovanni Dell'Ariccia, and Andrei Levchenko, 2008, "Credit Booms: The Good, the Bad, and the Ugly," Unpublished manuscript, International Monetary Fund (Washington, DC).

Basel Committee on Banking Supervision, 2010, "Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems" (Basel: Bank for International Settlements). Available at http://www.bis.org/publ/bcbs189.htm

Berger, Helge, Jakob de Haan, and Jan-Egbert Sturm, 2006, "Does Money Matter in the ECB Strategy? New Evidence Based on ECB Communication," CESIFO Working Paper No. 1652 (Munich: Center for Economic Studies).

Berger, Allen N., and Gregory F. Udell, 2004, "The Institutional Memory Hypothesis and the Procyclicality of Bank Lending Behavior," *Journal of Financial Intermediation*, Vol. 13, pp. 458-95.

Bernanke, Ben, and Mark Gertler, 1989, "Agency Costs, Net Worth, and Business Fluctuations," *American Economic Review*, Vol. 79, No. 1, pp. 14-31.

———, 1995, "Inside the Black Box: The Credit Channel of Monetary Policy Transmission," *Journal of Economic Perspectives*, Vol. 9, No. 4, pp. 27–48.

BIS (Bank for International Settlements), 2011, "Macroprudential Policy Tools and Frameworks," Update to G20 Finance Ministers and Central Bank Governors. Available at www.bis.org/publ/othp13.pdf

Boissay, Frédéric, Oscar Calvo-Gonzales, and Tomasz Kozluk, 2006, "Is Lending in Central and Eastern Europe Developing Too Fast?" in *Financial Development, Integration and Stability*, ed. by Klaus Liebscher, Josef Christl, Peter Mooslechner, and Doris Ritzberger-Grünwald (Cheltenham, U.K.: Edward Elgar Publishing).

Borio, Claudio, 2003, "Towards a Macroprudential Framework for Financial Supervision and Regulation?" *CESifo Economic Studies*, Vol. 49, No. 2, pp. 181–216.

_____, 2009, "The Macroprudential Approach to Regulation and Supervision," *VoxEU.org*, April 14. Available at http://www.voxeu.org/index.php?q=node/3445

Borio, Claudio, and Philippe Lowe, 2002, "Asset Prices, Financial and Monetary Stability: Exploring the Nexus," BIS Working Paper No. 114 (Basel: Bank for International Settlements).

Borio, Claudio, Robert McCauley, and Patrick McGuire, 2011, "Global Credit and Domestic Credit Booms," *BIS Quarterly Review*, September, pp. 43-57.

Borio, Claudio, and Ilhyock Shim, 2007, "What Can (Macro-) Prudential Policy Do to Support Monetary Policy?" BIS Working Paper No. 242 (Basel: Bank for International Settlements).

Borio, Claudio, and Haibin Zhu, 2008, "Capital Regulation, Risk-taking and Monetary Policy: A Missing Link in the Transmission Mechanism?" BIS Working Paper No. 268 (Basel: Bank for International Settlements).

Brzoza-Brzezina, Michał, Tomasz Chmielewski, and Joanna Niedźwiedzińska, 2010, "Substitution Between Domestic and Foreign Currency Loans in Central Europe: Do Central Banks Matter?" European Central Bank Working Paper No. 1187.

Caprio, Gerard, Daniela Klingebiel, Luc Laeven, and Guillermo Noguera, 2005, "Appendix: Banking Crisis Database," in *Systemic Financial Crises: Containment and Resolution* ed. by Patrick Honohan and Luc Laeven (Cambridge, U.K.: Cambridge University Press).

Claessens, Stijn, Giovanni Dell'Ariccia, Deniz Igan, and Luc Laeven, 2010, "Cross-Country Experiences and Policy Implications from the Global Financial Crisis," *Economic Policy*, Vol. 25, No. 62, pp. 267-93.

Claessens, Stijn, Michael Keen, and Ceyla Pazarbasioglu, 2010, "Financial Sector Taxation," IMF report with background material presented to the G-20 (Washington, DC: International Monetary Fund).

Claessens, Stijn, Ayhan Kose, and Marco E. Terrones, 2012, "How Do Business and Financial Cycles Interact?" *Journal of International Economics*, Vol. 87, No. 1, May 2012, pp. 178-90.

Cottarelli, Carlo, Giovanni Dell'Ariccia, and Ivanna Vladkova-Hollar, 2003, "Early Birds, Late Risers, and Sleeping Beauties: Bank Credit Growth to the Private Sector in Central and Eastern Europe and the Balkans," IMF Working Paper No. 03/213 (Washington, DC: International Monetary Fund).

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

Decressin, Jörg, and Marco Terrones, 2011, "Credit Boom-Bust Cycles: Their Triggers and Policy Implications," Box 1.2 in *World Economic Outlook*, September (Washington, DC: International Monetary Fund).

Dell'Ariccia, Giovanni, Deniz Igan, and Luc Laeven, 2008, "Credit Booms and Lending Standards: Evidence from the Subprime Mortgage Market," *Journal of Money, Credit, and Banking*, forthcoming.

Dell'Ariccia, Giovanni, and Robert Marquez, 2006, "Lending Booms and Lending Standards," *Journal of Finance,* Vol. 61, No. 5, pp. 2511–546.

De Nicolò, Gianni, Giovanni Dell'Ariccia, Luc Laeven, and Fabian Valencia, 2010, "Monetary Policy and Bank Risk-Taking," Staff Position Note, 2010/09 (Washington, DC: International Monetary Fund).

De Nicolò, Gianni, Giovanni Favara, and Lev Ratnovski, 2012, "Externalities and Macroprudential Policy," Staff Position Note, forthcoming (Washington, DC: International Monetary Fund).

Detragiache, Enrica, Jérôme Vandenbussche, and Ursula Vogel, 2012, "Macroprudential Policies and Housing Prices: Evidence from CESEE," IMF Working Paper, forthcoming (Washington, DC: International Monetary Fund).

Drehmann, Mathias, Claudio Borio, and Kostas Tsatsaronis, 2011, "Anchoring Countercyclical Capital Buffers: The Role of Credit Aggregates," BIS Working Paper No. 355 (Basel: Bank for International Settlements).

Duenwald, Christoph, Nikolay Gueorguiev, and Andrea Schaechter, 2005, "Too Much of a Good Thing? Credit Booms in Transition Economies," IMF Working Paper No. 5/128 (Washington, DC: International Monetary Fund).

ECB (European Central Bank), 1999, "The Stability-Oriented Monetary Policy Strategy of the Eurosystem," *ECB Monthly Bulletin*, January, pp. 39-50.

Eichengreen, Barry, and Kris Mitchener, 2003, "The Great Depression as a Credit Boom Gone Wrong," BIS Working Paper No. 137 (Basel: Bank for International Settlements).

Enoch, Charles, and Inci Ötker-Robe, 2007, Rapid Credit Growth in Central and Eastern Europe: Endless Boom or Early Warning? (New York, NY: Palgrave Macmillan).

Favara, Giovanni, 2003, "An Empirical Reassessment of the Relationship Between Finance and Growth," IMF Working Paper No. 03/123 (Washington, DC: International Monetary Fund).

FSA (Financial Services Authority), 2009, "The Turner Review: A Regulatory Response to the Global Banking Crisis," March (London: Financial Services Authority). Available at www.fsa.gov.uk/pubs/other/turner_review.pdf

Gilchrist, Simon, and Egon Zakrajsek, 2008, "Linkages between the Financial and Real Sectors: An Overview," paper prepared for the Academic Consultants Meeting, Federal Reserve Board, October 3.

Gourinchas, Pierre-Olivier, Rodrigo Valdes, and Oscar Landerretche, 2001, "Lending Booms: Latin America and the World," *Economia*, Vol. 1, No. 2, pp. 47-99.

Hilbers, Paul, Inci Ötker-Robe, Ceyla Pazarbasioglu, and Gudrun Johnsen, 2005, "Assessing and Managing Rapid Credit Growth and the Role of Supervisory and Prudential Policies," IMF Working Paper No. 05/151 (Washington, DC: International Monetary Fund).

Igan, Deniz, Alain Kabundi, Francisco Nadal De Simone, Marcelo Pinheiro, and Natalia Tamirisa, 2011, "Housing, Credit, and Real Activity Cycles: Characteristics and Comovement," *Journal of Housing Economics*, Vol. 20, No.3, pp. 210-31.

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, DC: International Monetary Fund).

Igan, Deniz, and Marcelo Pinheiro, 2011, "Credit Growth and Bank Soundness: Fast and Furious?" IMF Working Paper No. 11/278 (Washington, DC: International Monetary Fund).

IMF, 2010, "Building Confidence," Europe Regional Economic Outlook, October (Washington, DC: International Monetary Fund). Available at www.imf.org/external/pubs/ft/reo/2010/eur/eng/ereo1010.pdf

_____, 2011a, "Macroprudential Policy: An Organizing Framework" (Washington, DC: International Monetary Fund). Available at www.imf.org/external/np/pp/eng/2011/031411.pdf

_____, 2011b, "Macroprudential Policy: An Organizing Framework - Background Paper," (Washington, DC: International Monetary Fund). Available at www.imf.org/external/np/pp/eng/2011/031411a.pdf

Jeanne, Olivier, 2008, "Dealing with Credit Booms and Busts: The Case for Prudential Taxation," Remarks at "Building an International Monetary and Financial System for the

21st Century: Agenda for Reform," conference organized by the Reinventing Bretton Woods Committee, New York, November 24-25.

Jeanne, Olivier, and Anton Korinek, 2010, "Managing Credit Booms and Busts: A Pigouvian Taxation Approach," NBER Working Paper No. 16377 (Cambridge, MA: National Bureau of Economic Research).

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró, and Jesús Saurina, 2011, "Macroprudential Policy, Countercyclical Bank Capital Buffers and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments," Working Paper (Madrid: Bank of Spain [Banco de Espana]).

Jordà, Òscar, Moritz Schularick, and Alan M. Taylor, 2011, "Financial Crises, Credit Booms, and External Imbalances: 140 Years of Lessons," *IMF Economic Review*, Vol. 59, June, pp. 340-78.

Kane, Edward J., 1977, "Good Intentions and Unintended Evil: The Case Against Selective Credit Allocation," *Journal of Money, Credit, and Banking*, Vol. 9, No. 1, pp. 55-69.

Keen, Michael, and Ruud de Mooij, 2012, "Debt, Taxes, and Banks," IMF Working Paper No. 12/48 (Washington, DC: International Monetary Fund).

King, Robert G., and Ross Levine, 1993, "Finance and Growth: Schumpeter Might Be Right," *Quarterly Journal of Economics*, Vol. 108, pp. 717-37.

Kiyotaki, Nobuhiro, and John Moore, 1997, "Credit Cycles," *Journal of Political Economy*, Vol. 105, pp. 211-48.

Kongsamut, Piyabha, and Jérôme Vandenbussche, 2012, "The Eastern European Experience with Macroprudential Policies: Evidence from Bulgaria, Croatia, Romania and Serbia During the Latest Credit Boom-Bust Cycle," IMF Working Paper, forthcoming (Washington, DC: International Monetary Fund).

Kraft, Evan, and Tomislav Galac, 2011, "Macroprudential Regulation of Credit Booms and Busts: the Case of Croatia," Policy Research Working Paper No. 5772 (Washington, DC: World Bank).

Kruszka, Michal, and Michal Kowalczyk, 2011, "Macro-Prudential Regulation of Credit Booms and Busts: The Case of Poland," Policy Research Working Paper No. 5832 (Washington, DC: World Bank).

Laeven, Luc, and Fabian Valencia, 2010, "Resolution of Banking Crises: The Good, the Bad, and the Ugly," IMF Working Paper No. 10/46 (Washington, DC: International Monetary Fund).

Leigh, Daniel, Deniz Igan, John Simon, and Petia Topalova, 2012, "Dealing with Household Debt," Chapter 3 in *World Economic Outlook*, April (Washington, DC: International Monetary Fund).

Levine, Ross, 2005, "Law, Endowments and Property Rights," *Journal of Economic Perspectives*, Vol. 19, No. 3, pp. 61-88.

Levine, Ross, Norman Loayza, and Thorsten Beck, 1999, "Financial Intermediation and Growth: Causality and Causes," Policy Research Working Paper No. 2059 (Washington, DC: World Bank).

Levine, Ross, and David Renelt, 1992, "A Sensitivity Analysis of Cross-Country Growth Regressions," *American Economic Review*, Vol. 82, No. 4, pp. 942-63.

Lim, Cheng Hoon, Francesco Columba, Alejo 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 No. 11/238 (Washington, DC: International Monetary Fund).

Maddaloni, Angela, and José-Luis Peydró, 2011, "Bank Risk-Taking, Securitization, and Low-Interest Rates: Evidence from the Euro-area and U.S. Lending Standards," *Review of Financial Studies*, Vol. 24, No. 6, pp. 2121-165.

Magud, Nicolas E., Carmen M. Reinhart, and Esteban R. Vesperoni, 2012, "Capital Inflows, Exchange Rate Flexibility, and Credit Booms," IMF Working Paper No. 12/41 (Washington, DC: International Monetary Fund).

Mendoza, Enrique, and Marco Terrones, 2008, "An Anatomy of Credit Booms: Evidence from Macro Aggregates and Micro Data," NBER Working Paper No. 14049 (Cambridge, MA: National Bureau of Economic Research).

Merrouche, Ourda, and Erlend Nier, 2010, "What Caused the Global Financial Crisis? – Evidence on the Drivers of Financial Imbalances 1999-2007," IMF Working Paper No. 10/265 (Washington, DC: International Monetary Fund).

Mitra, Srobona, Jaromír Beneš, Silvia Iorgova, Kasper Lund-Jensen, Christian Schmieder, and Tiago Severo, 2011, "Toward Operationalizing Macroprudential Policies: When to Act?" Chapter 3 in *Global Financial Stability Report*, September (Washington, DC: International Monetary Fund).

Ostry, Jonathan D., Atish Ghosh, Karl Habermeier, Luc Laeven, Marcos Chamon, Mahvash S. Qureshi, and Annamaria Kokenyne, 2011, "Managing Capital Inflows: What Tools to Use?" IMF Staff Discussion Note No. 11/06 (Washington, DC: International Monetary Fund).

Rajan, Raghuram G., 1994, "Why Bank Credit Policies Fluctuate: A Theory and Some Evidence," *Quarterly Journal of Economics*, Vol. 109, No. 2, pp. 399-441.

Rajan, Raghuram G., and Luigi Zingales, 1998, "Financial Dependence and Growth," *American Economic Review*, Vol. 88, No. 3, pp. 559-86.

Rancière, Romain, Aaron Tornell, and Frank Westermann, 2008, "Systemic Crises and Growth," *Quarterly Journal of Economics*, Vol. 123, No. 1, pp. 359-406.

Reinhart, Carmen M., and Kenneth S. Rogoff, 2004, "The Modern History of Exchange Rate Arrangements: A Reinterpretation," *Quarterly Journal of Economics*, Vol. 119, No. 1, pp. 1-48.

Reinhart, Carmen M., and Kenneth S. Rogoff, 2009, "The Aftermath of Financial Crises," NBER Working Paper No. 14656 (Cambridge, MA: National Bureau of Economic Research).

Ruckes, Martin, 2004, "Bank Competition and Credit Standards," *Review of Financial Studies*, Vol. 17, No. 4, pp. 1073-102.

Schularick, Moritz, and Alan M. Taylor, 2009, "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles and Financial Crises, 1870-2008," CEPR Discussion Paper No. 7570 (London, U.K.: Centre for Economic Policy Research).

Svensson, Lars E.O., 2003, "In the Right Direction, But Not Enough: The Modification of the Monetary-Policy Strategy of the ECB," Briefing paper for the Committee on Economic and Monetary Affairs (ECON) of the European Parliament.

Terrier, Gilbert, Rodrigo Valdés, Camilo E. Tovar, Jorge Chan-Lau, Carlos Fernández-Valdovinos, Mercedes García-Escribano, Carlos Medeiros, Man-Keung Tang, Mercedes Vera Martin, and Chris Walker, 2011, "Policy Instruments to Lean Against the Wind in Latin America," IMF Working Paper No. 11/159 (Washington, DC: International Monetary Fund).

Terrones, Marco, 2004, "Are Credit Booms in Emerging Markets a Concern?" Chapter 4 in *World Economic Outlook*, April (Washington, DC: International Monetary Fund).

Woodford, Michael, 2008, "How Important Is Money in the Conduct of Monetary Policy?" *Journal of Money, Credit and Banking*, Vol. 40, No. 8, pp. 1561-598.

Wong, Eric, Tom Fong, Ka-fai Li, and Henry Choi, 2011, "Loan-to-Value Ratio as a Macroprudential Tool: Hong Kong's Experience and Cross-Country Evidence," Working Paper No. 01/2011 (Hong Kong: Hong Kong Monetary Authority).

Table 1. Economic Performance

	All years	
	Non-boom years	Booms
Average change in:		
Credit-to-GDP	1.6	16.8
GDP	3.1	5.4
Consumption	4.0	5.4
Investment	4.2	10.3
Equity prices	3.8	11.0
House prices	1.8	9.5
Exchange rate	5.1	2.5
Inflation	10.7	9.3
Current account	0.2	-1.2

Notes: Average across all credit boom episodes. Average annual changes expressed in percent.

Table 2. Long-Term Growth and Credit Booms

Years spent in a boom:	Change in Real Per Capita Income	
	Mean	Median
None	40%	38%
Between 1 and 5	54%	60%
More than 5	61%	59%

Table 3. Credit Booms Gone Wrong

Followed by financial crisis?	Followed by economic underperformance?					
	No		Yes		Total	
	Number	Percent of total cases	Number	Percent of total cases	Number	Percent of total cases
No	54	31%	64	37%	118	67%
Yes	16	9%	41	23%	57	33%
Total	70	40%	105	60%	175	

Notes: Number and proportion of credit boom episodes are shown. A boom is followed by a financial crisis if a banking crisis happened within the three-year period after the end of the boom and is followed by economic underperformance if real GDP growth was below its trend, calculated by applying a moving-average filter, within the six-year period after the end of the boom.

Table 4. Economic and Financial Policy Frameworks and Credit Booms, 1970-2009
(frequency distribution, in percent)

	Exchange Rate Regime		Monetary Policy		Fiscal Policy		Banking Supervision	
	Fixed	Floating	Loose	Tight	Loose	Tight	Low	High
1970-79	10.6	5.6	7.2	9.4	12.5	4.8	14.9	1.1
1980-89	11.3	9.4	16.5	2.2	19.2	7.7	22.3	0.6
1990-99	23.1	4.4	24.5	0.7	26.0	10.6	24.6	2.3
2000-09	27.5	8.1	33.8	5.8	13.5	5.8	18.9	15.4
All years	72.5	27.5	82.0	18.0	71.2	28.8	80.6	19.4

Notes: Exchange rate regime categories are based on Reinhart and Rogoff (2004). Monetary policy is tight when the policy rate exceeds the predicted level based on a simple regression of policy rates on inflation and real GDP growth by more than 25 percent (the top quartile). Fiscal policy is tight when the change in the deficit/surplus exceeds its predicted level based on a simple regression of the deficit/surplus on real GDP growth by more than 1.7 percent of GDP (the top quartile). Banking supervision quality measure is from Abiad, Detragiache, and Tressel (2008).

Table 5. Policy Responses to Credit Booms

Measure	Countries	Impact assessment
Macroeconomic policy		
Monetary tightening	Australia, Brazil, Chile, China, Colombia, Croatia, Hungary, Iceland, Latvia, Romania, Sweden	Higher interest rates did not prove to be effective in controlling domestic demand for loans. In some cases, increased capital inflows and/or shift to FX-denominated loans posed further challenges.
Fiscal tightening	Bulgaria, Hungary	Fiscal consolidation, in most cases, was not enough to offset the surge in domestic demand.
Removal of incentives for borrowing in the tax code	Estonia, Lithuania*, Netherlands, Poland, United Kingdom	Gradual facing out of mortgage interest deductibility was somewhat successful in the U.K. but did not have much effect on household debt accumulation in the other cases.
Regulatory policy		
Reserve requirements	Albania, Bosnia, Brazil, Bulgaria, China, Colombia, Croatia, Estonia, Finland, India, Indonesia, Korea, Latvia, Malaysia, Mongolia*, Peru^*, Romania^, Russia^, Serbia, Ukraine, Uruguay^	Evidence remains mixed with success in taming the rate of growth reported in some cases (e.g., Bosnia) but not in others (e.g., Serbia).
Differentiated/Time-varying capital requirements	Brazil, Bulgaria, Croatia, Greece, India, Nigeria, Poland^, Portugal^, Switzerland*	Sizeable slowdown in credit growth rates was noted in several cases but reversal to higher pace was not uncommon. Some have argued that these tools, even when they failed to prevent or curb a credit boom, were effective in ensuring that the banking sector was better prepared for the bust as capital buffers were higher.
Higher risk weights	Albania, Bulgaria, Brazil*, Croatia, Estonia^, Iceland, India, Ireland, Italy, Malaysia, Norway^, Poland^, Serbia, Spain, Turkey, Uruguay^	
Liquidity requirements	Argentina^, Brazil^, Colombia, Croatia, France*, Iceland, New Zealand*, Turkey^, Uruguay^	More than the impact on credit growth, the improvement in liquidity positions were to praise.
Dynamic/Increased provisioning	Bolivia, Bulgaria, Colombia, Croatia, Greece, India, Mongolia*, Peru, Portugal, Russia, Spain, Uruguay	In many cases, there was some but not large effect on the rate of credit growth. However, the buffer built during the boom appeared to have helped during the bust.
Limits on credit growth/new loans	Argentina^, Austria^, Bulgaria, Brazil^, China, Colombia, Croatia, Greece, Hong Kong SAR, Hungary^*, Korea^*, Malaysia, Romania^, Serbia, Singapore, Turkey^	There has been some effect, especially when the measures were applied only to narrowly-defined categories of loans. Yet, overall effectiveness on aggregate credit was muted as lending shifted to foreign banks or less-regulated financial intermediaries.
Limits on loan-to-value ratio	Brazil^*, Canada*, Chile, China, Colombia, Hong Kong SAR, Hungary^*, India, Korea, Latvia, Malaysia, Norway*, Romania, Singapore, Slovak Republic, Sweden*, Thailand, Turkey*	Studies focusing on Asian countries report success for such loan eligibility criteria both in curtailing real estate price appreciation and in reducing defaults if and when a downturn starts. There tends to be, however, less support for these tools' ability to control household and bank leverage. Also, issues concerning the calibration of the policy response remain (see, e.g., Igan and Kang, 2011). Evidence for other countries is even more limited since the rules have only recently been enforced.
Limits on debt-to-income ratio	China, Colombia, France*, Greece, Hong Kong SAR, Hungary^*, Korea, Malaysia, Norway*, Poland*, Romania, Thailand	
Exposure/Credit concentration limits	Colombia, France, Hong Kong SAR, Malaysia, Mexico, Mongolia*, New Zealand*, Nigeria, Peru*, Poland, Portugal, Romania, Serbia, South Africa, Thailand, Ukraine, Uruguay	Direct impact on aggregate credit growth rate is difficult to detect, but positive effect on the resilience of financial institutions seems to exist. Having said that, circumvention problems have been reported, especially in the case of exposure or credit concentration limits.
Net open position limits	Argentina, Colombia, Hungary, Indonesia, Israel^*, Korea^*, Malaysia, Mexico, Nigeria, Peru*, Romania, Russia, Serbia, South Africa, Thailand, Turkey, Uruguay	
Maturity mismatch regulations	Italy, Mexico, Mongolia*, New Zealand*, Singapore, South Africa, Uruguay	

Sources: IMF country reports; Enoch and Ötker-Robe (2007); Borio and Shim (2007); Crowe and others (2011); Lim and others (2011); Terrier and others (2011); Detragiache, Vandenbussche, and Vogel (2012).
Note: This is not intended to be an exhaustive list of all measures taken in all credit boom episodes identified in the sample but rather a simplified illustration of various tools used in various cases. Some measures can be classified under multiple categories, e.g., application of higher risk weights or additional capital requirements based on whether the loan meets a loan-to-value limit criterion, and in most cases several policy tools are used in one package. Tools listed under regulatory policy have been used in a prudential rather than in a "macroprudential" sense in most cases, especially before the global financial crisis, and such usage may not necessarily fit within the definition of macroprudential policy used since the crisis (see BIS, 2011, and IMF, 2011a, for such definitions). ^ denotes the cases in which the measure was applicable to a certain type of lending, most commonly, foreign-currency-denominated loans. * indicates that the measure was taken very recently (in 2010 or later), in several cases as a response to the global financial crisis rather than to an ongoing or looming credit boom.

Table 6. Policy Options to Deal with Credit Booms

	Potential impact	Side effects	Practical issues
Macroeconomic Policy			
Monetary measures			
Tightening of monetary policy (e.g., through a rise in key policy rates)	drain excess liquidity in the system, increase the cost of borrowing, and potentially reduce the deterioration in inflation and current account	inflict damage to economic activity and welfare; attract capital inflows; hurt fiscal position by raising the cost of borrowing	identifying 'doomed' booms and reacting in time; weakness in monetary transmission mechanism; constraints imposed by monetary regime
Fiscal measures			
Tightening of fiscal policy	reduce potential overheating related to credit expansion and create room for stimulus in case of a bust	potential output costs that may come with significant tightening	considerable lag in fully mobilizing the measures and little room if the fiscal stance is already tight
Removal of incentives for borrowing (e.g., mortgage interest tax deductibility, subsidies/guarantees for mortgages, corporate tax shield provided by debt)	reduce distortions in the demand for bank loans and other types of debt	conflicts with socially-motivated housing goals	only a one-off effect with little room for cyclical implementation
Financial sector taxation	reduce probability of crisis by dampening systemic excessive risk taking during the boom and cost of crisis by acting as a buffer in the bust phase	risk of imposing excessive costs on the financial sector and, thus, impairing financial intermediation	loopholes for tax arbitrage and tax havens in the absence of international coordination; design details still in infancy
Regulatory Policy			
Macroprudential measures			
Reserve requirements Differentiated capital requirements Higher risk weights Liquidity requirements	increase cost of borrowing while building buffer to cope with the bust	costs associated with potential credit rationing	may get too complicated to enforce, especially in a cyclical context; effectiveness also limited when capital ratios are already high
Dynamic provisioning	increase cost of borrowing while building buffer to cope with the bust	earnings management	data requirements and calibration
Limits on credit growth	(could) limit rapid expansion and leverage	loss of benefits from financial deepening	move lending outside the regulatory periphery
Limits on loan-to-value ratio Limits on debt-to-income ratio	(could) limit rapid expansion and leverage while decreasing probability of default	costs associated with potential credit rationing	calibration is difficult, circumvention is easy
Credit concentration limits Net open position limits Maturity mismatch regulations	limit exposure to certain types or sources of risks	not directly aimed at the aggregate credit growth; may shift risks to other types or sources of risk	window-dressing and circumvention may be an issue
Monitoring measures			
Intensified surveillance on vulnerable Stress testing Stronger disclosure requirements	improve resilience of the financial sector in the aftermath	reliance on hard information and less incentive to gather soft information; (potentially) increase rent-seeking	difficult to take action at good times, may still miss tail risks

Table 7. Regression Analysis: Incidence of Credit Booms

Dependent variable: Dummy=1 if there is a credit boom					
	(1)	(2)	(3)	(4)	(5)
GDP per capita	-0.0146	-0.0191	-0.0062	-0.0818**	-0.0643
	[0.0299]	[0.0299]	[0.0337]	[0.0379]	[0.0388]
GDP growth	0.0155	0.0125	0.0127	0.0260**	0.0270*
	[0.0133]	[0.0147]	[0.0152]	[0.0120]	[0.0161]
Capital inflow surge	0.0222	0.0124	0.0199	0.0185	0.0107
	[0.0147]	[0.0153]	[0.0204]	[0.0137]	[0.0204]
Financial reform	0.3142*	0.2126	0.1942	0.4379**	0.2199
	[0.1861]	[0.2074]	[0.1990]	[0.1889]	[0.2178]
Inflation	-0.0018	-0.0058	-0.0035	-0.0028	-0.0065
	[0.0054]	[0.0062]	[0.0057]	[0.0050]	[0.0063]
Current account balance	0.0079	0.0047	0.0006	0.0094	0.0024
	[0.0095]	[0.0112]	[0.0139]	[0.0081]	[0.0154]
Trade openness	-0.0020*	-0.0014	-0.0008	-0.0021**	-0.0006
	[0.0010]	[0.0011]	[0.0012]	[0.0010]	[0.0013]
Exchange rate regime	-0.0263**	-0.0182*	-0.013	-0.0173*	0.0007
	[0.0105]	[0.0103]	[0.0122]	[0.0104]	[0.0115]
Monetary policy stance		-0.0017**			-0.0011
		[0.0007]			[0.0009]
Fiscal policy stance			0.1233***		0.1190***
			[0.0339]		[0.0342]
Macroprudential controls				-0.0782***	-0.0724***
				[0.0189]	[0.0193]
Observations	150	147	134	150	131

Notes: All regressions are estimated using OLS. GDP per capita, in real terms, is in log. GDP growth is the annual growth rate of real GDP. Capital inflow surge is the sum of direct, other and portfolio investment flows as percent of GDP. Financial reform is a normalized index, as calculated by Abiad, Detragiache, and Tressel (2008), with higher values indicating a more liberal and standardized regulatory framework. Inflation is the annual increase in CPI. Current account balance is expressed in percent of GDP. Trade openness is the sum of exports and imports divided by GDP. Exchange rate regime is the Reinhart-Rogoff fine classification, with higher values corresponding to more flexibility in exchange rate determination. Monetary policy stance is calculated as the error term by which the policy rate exceeds its predicted level based on a simple regression of policy rates on inflation and real GDP growth. Fiscal policy stance is computed as the error term by which the general government deficit/surplus in percent of GDP deviates from its predicted level based on a simple regression of the deficit/surplus on real GDP growth. Macroprudential controls variable is the count of macroprudential tools such as reserve and liquidity requirements, foreign exchange open position limits, or interest rate controls. All variables except the categorical ones are winsorized at the 5 percent level. All variables are lagged to reflect their average over the 3-year period before the start of the boom. They are calculated as the average for the sample period if the country has undergone no booms. Robust standard errors are in brackets. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table 8. Regression Analysis: Policy Effectiveness in Preventing Credit Booms from Going Wrong

	DV: Dummy=1 if bad				DV: Dummy=1 if banking crisis				DV: Dummy=1 if economic underperformance			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Duration	0.0564**	0.0369	0.0530**	0.0392	0.0297	0.0425	0.0359*	0.0379	0.0461*	0.0077	0.0409*	0.0134
	[0.0234]	[0.0261]	[0.0210]	[0.0250]	[0.0234]	[0.0273]	[0.0213]	[0.0261]	[0.0244]	[0.0280]	[0.0229]	[0.0285]
Monetary policy	0.0482			0.056	-0.0512			-0.0656	0.0773			0.1876
	[0.1179]			[0.1502]	[0.1183]			[0.1580]	[0.1229]			[0.1503]
Fiscal policy		0.0160		0.1157		0.0735		0.0996		0.0757		0.1913
		[0.1137]		[0.1122]		[0.1193]		[0.1283]		[0.1218]		[0.1240]
Macroprudential policy			-0.2113***	-0.1342			-0.2372***	-0.2306**			-0.1015	-0.0248
			[0.0684]	[0.0994]			[0.0678]	[0.0906]			[0.0745]	[0.0989]
Observations	141	109	173	94	141	109	173	94	141	109	173	94

Notes: All regressions are estimated using OLS. Duration, measured in years, shows how long the boom has lasted and is also a proxy for its size. Monetary/Fiscal policy in a given year is measured by a dummy that is 1 if there was tightening. Monetary policy is deemed to have tightened when the policy rate exceeds the predicted level based on a simple regression of policy rates on inflation and real GDP growth by more than 25 percent (the top quartile). Fiscal policy is deemed to have tightened when the change in the deficit/surplus exceeds its predicted level based on a simple regression of the deficit/surplus on real GDP growth by more than 1.7 percent of GDP (the top quartile). Macroprudential policy is an indicator variable that takes on the value 1 if at least one macroprudential tool was introduced right before the start of the boom and 0 otherwise. For all policy variables except the indicator variable for macroprudential policy which is the value in the year before the start of the boom, the average over the boom years is taken. Sample consists of boom episodes only. Standard errors are in brackets. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

Table A1. Correlation of Booms across Definitions

Boom dummy constructed using:	(1)	(2)	(3)	(4)
Ad hoc threshold 1/	1			
Backward-looking, rolling, cubic trend 2/	0.99*	1		
Hodrick-Prescott over entire series 3/	0.50*	0.52*	1	
Hodrick-Prescott from t_0 to t 4/				
Absolute	0.55*	0.58*	0.63*	1
Relative	0.75*	0.80*	0.47*	0.84*

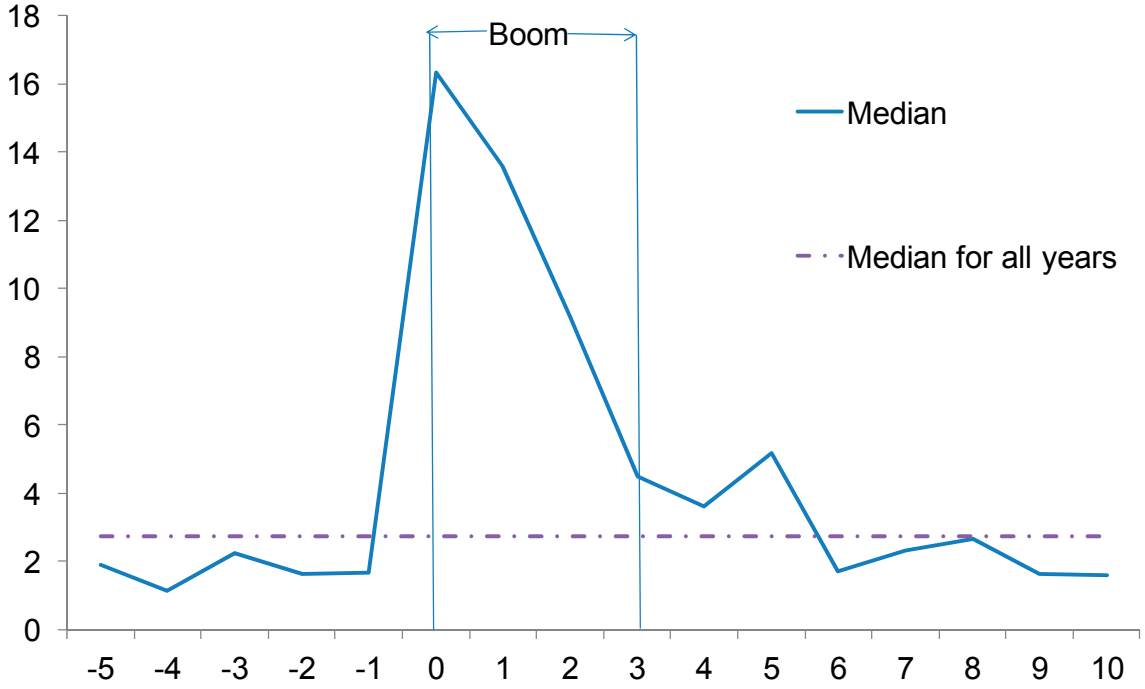
* indicates statistical significance at the 1 percent level.
1/ Boom if credit-to-GDP ratio increases by more than 20 percent.
2/ Barajas, Dell'Ariccia, and Levchenko (2008) definition. Baseline used in this paper.
3/ Mendoza and Terrones (2008) definition.
4/ Gourinchas, Valdes, and Landerretche (2001) definition.

Table A2. Incidence of Bad Booms across Definitions

Boom episodes identified using:	Number of booms	Followed by banking crises within three years from end
Ad hoc threshold 1/	112	38%
Backward-looking, rolling, cubic trend 2/	175	33%
Hodrick-Prescott over entire series 3/	112	37%
Hodrick-Prescott from t_0 to t 4/		
Absolute	138	43%
Relative	60	42%

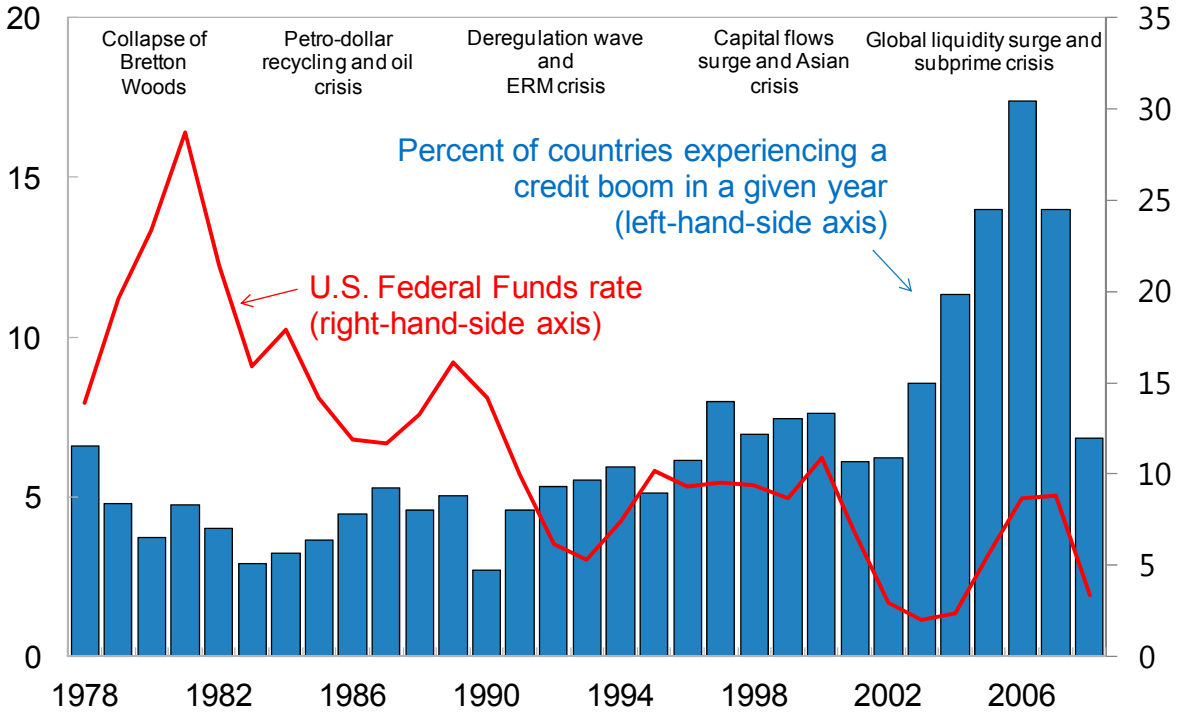
1/ Boom if credit-to-GDP ratio increases by more than 20 percent.
2/ Barajas, Dell'Ariccia, and Levchenko (2008) definition. Baseline used in this paper.
3/ Mendoza and Terrones (2008) definition.
4/ Gourinchas, Valdes, and Landerretche (2001) definition.

Figure 1. A Typical Credit Boom
(Growth rate of credit-to-GDP ratio around boom episodes)



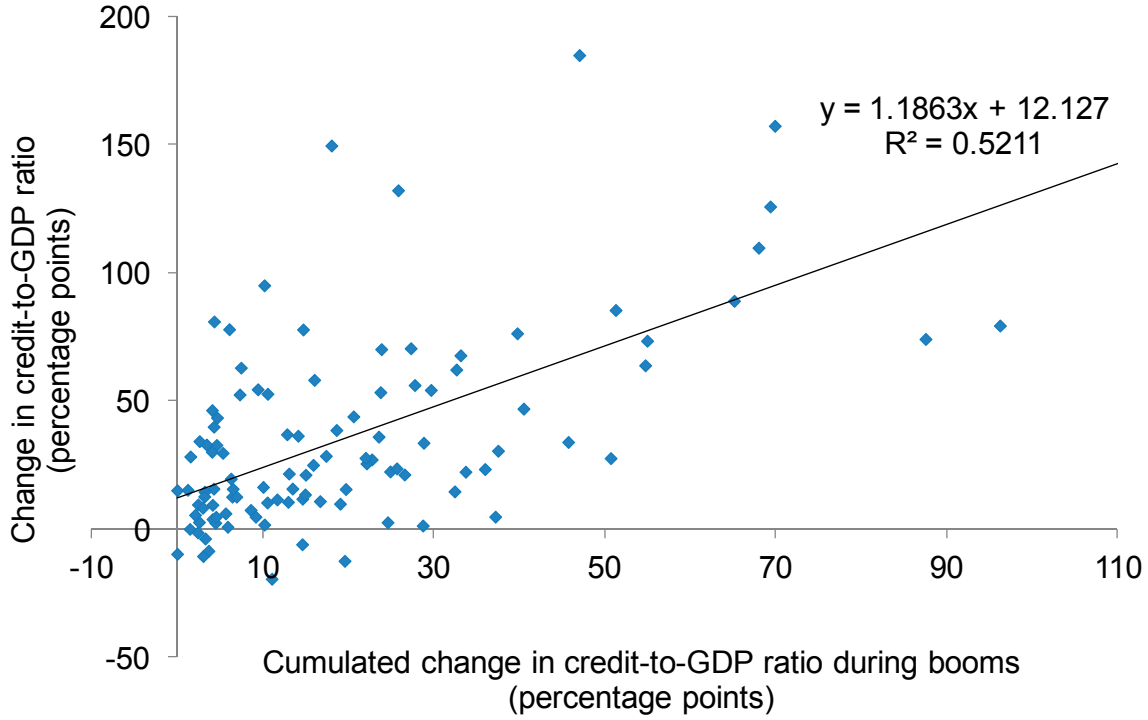
Sources: IMF *International Financial Statistics*; staff calculations.

Figure 2. Concurrence of Credit Booms, 1978-2008



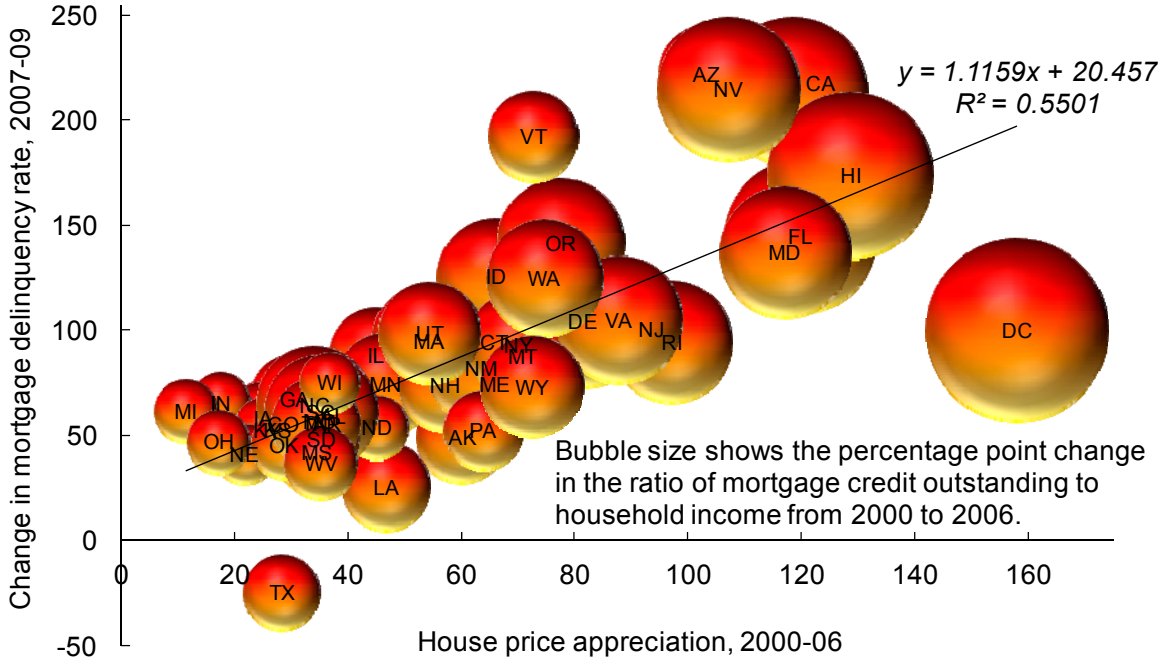
Sources: IMF *International Financial Statistics;* staff calculations.

Figure 3. Credit Booms and Financial Deepening,1970-2010



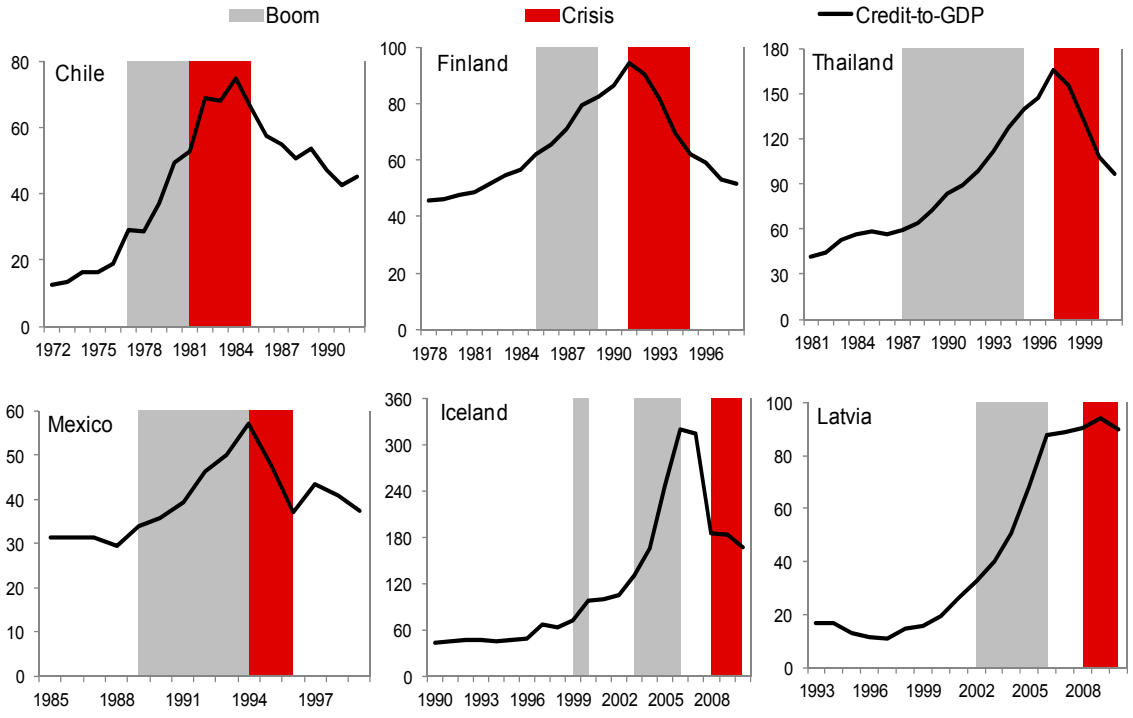
Sources: IMF *International Financial Statistics;* staff calculations.

Figure 4. Leverage: Linking Booms to Defaults



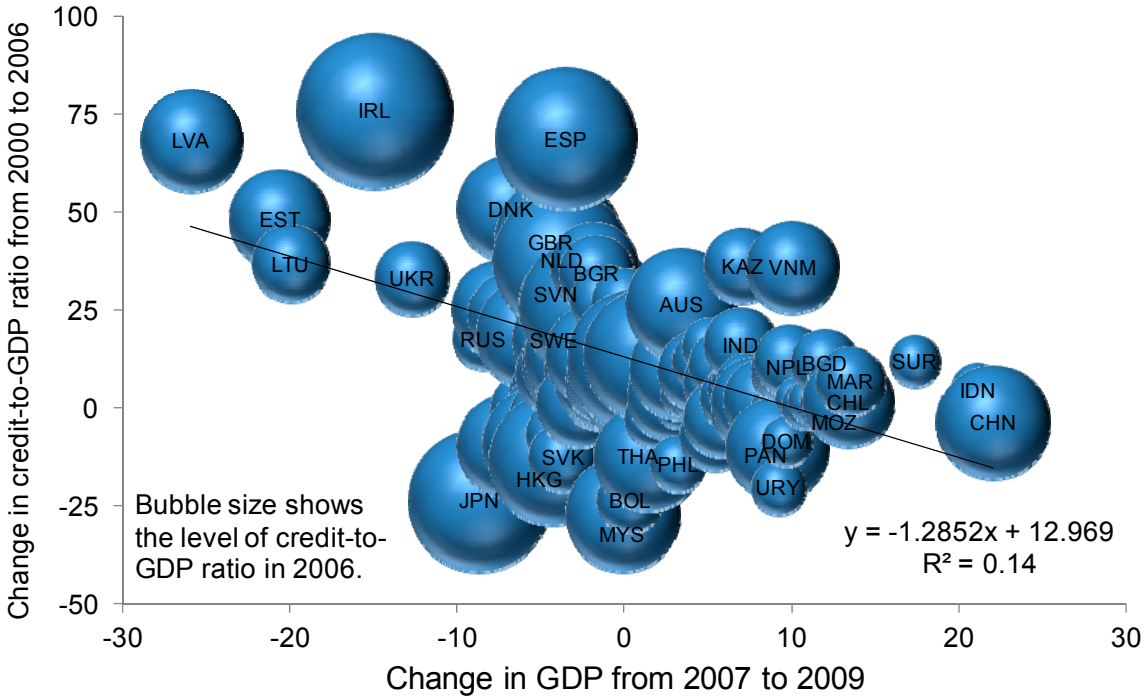
Sources: Federal Housing Finance Agency, Mortgage Bankers Association, Bureau of Economic Analysis, U.S. Census Bureau.
Note: Each data point corresponds to a U.S. state, indicated by the two-letter abbreviations.

Figure 5. Credit Booms and Financial Crises: Examples of Bad Booms



Sources: Laeven and Valencia (2010), IMF *International Financial Statistics*; staff calculations.

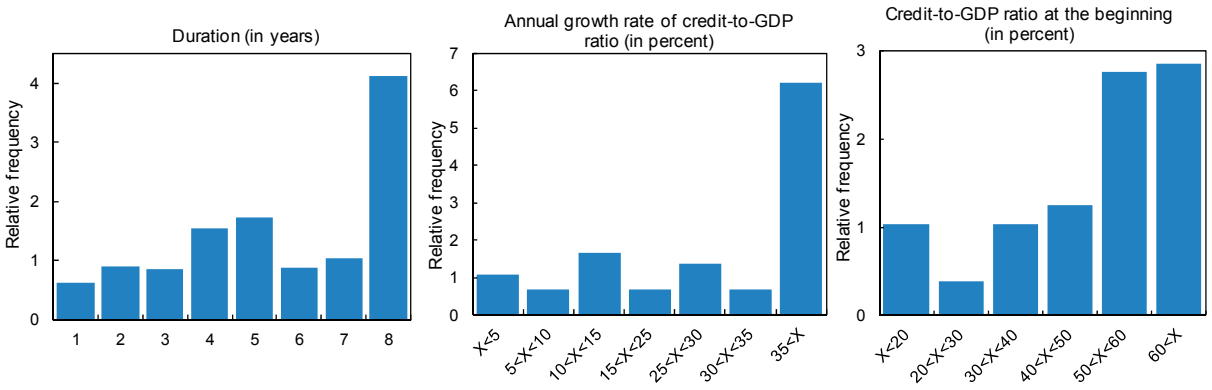
Figure 6. Credit Growth and Depth of Recession



Sources: IMF *International Financial Statistics*; staff calculations.
Note: Each data point corresponds to a country, indicated by the three-letter abbreviations.

Figure 7. Bad versus Good Booms

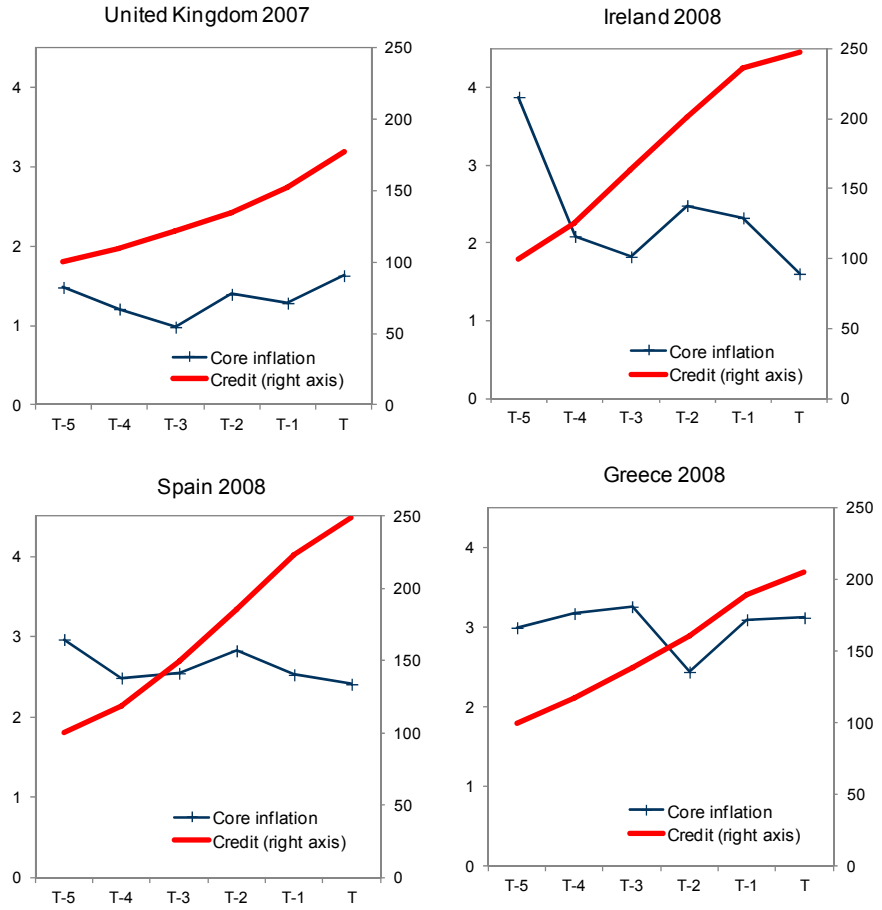
Booms that last longer and that develop faster are more likely to end up badly. Booms that start at a high level of credit-to-GDP also tend to be bad.



Sources: IMF *International Financial Statistics*; staff calculations.
Notes: Relative frequency is the frequency of a given attribute in bad booms divided by the frequency in good booms. Credit booms are identified as episodes during which the growth rate of credit-to-GDP ratio exceeds the growth rate implied by this ratio's backward-looking, country-specific trend by a certain threshold. Bad booms are those that are followed by a banking crisis within three years of their end.

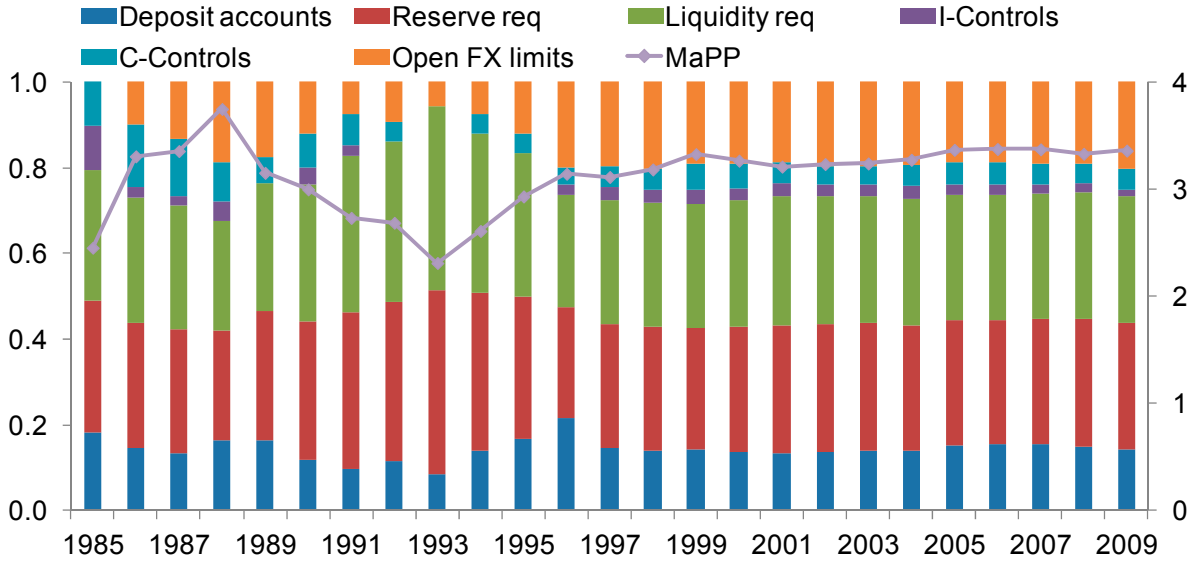
Figure 8. Credit Growth and Monetary Policy

(Selected countries that had a boom in the run-up and a crisis in 2007-08)



Sources: IMF *International Financial Statistics*, World Economic Outlook; staff calculations.
Notes: Credit is indexed with a base value of 100 five years prior to the crisis.

Figure 9. Macroprudential Index and its Components



Sources: IMF Annual Report on Exchange Arrangements and Exchange Restrictions, Article IV reports, surveys with country teams and country authorities (IMF, 2011b).
Notes: Deposit accounts, I-Controls, C-Controls, and MaPP stand for differential treatment of deposit accounts, interest rate controls, credit controls, and macroprudential policy (the composite measure), respectively. Each component, shown on the left-hand-side axis, is indicated by the proportion of countries adopting it in a given year. MaPP, shown on the right-hand-side axis, is constructed as the within-year average of the within-country sum of component dummies.