Macrofinancial stability

SUMMARY

This paper explores several questions about credit booms and busts: When do credit booms occur? When do they end up in busts, and when do they not? What are the implications for different policies if curbing credit growth and/or mitigating the associated risks is an objective? We find that credit booms are often associated with financial reform and economic growth. They also tend to be more frequent in fixed exchange rate regimes. Only one in three credit boom episodes are followed by a financial crisis. These booms tend to be larger and last longer. Macroprudential tools have at times proven effective in containing booms, and more often in limiting the consequences of busts, due to the buffers they helped to build.

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Credit booms and macrofinancial stability

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IMF and CEPR; IMF; ECB and CEPR; IMF

1. 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 are often associated with financial crises (Reinhart and Rogoff, 2009). Historically, only a minority (albeit a significant one) 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 et al., 2001; Borio and Lowe, 2002; Enoch and Ötker-Robe, 2007).

[1] The views expressed here are our own and should not be attributed to the ECB, the IMF or the IMF Board. This paper was prepared for the October 2015 Economic Policy Panel meeting. The authors would like to thank Thorsten Beck (the Editor), three anonymous referees, Nicolas Coeurdacier and José-Luis Peydró (the discussants), Olivier Blanchard, Claudio Borio, Stijn Claessens, Luis Cubeddu, Laura Kodres, Srobona Mitra, Maurice Obstfeld, Ratna Sahay, Marco Terrones and Kostas Tsatsaronis for useful comments and discussions. Joshua Bosshardt, Paola Ganum, Roxana Mihet and Jeanne Verrier provided excellent research assistance.

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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 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: 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 hardest-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 that is adjusted upward '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 and are crucial for macrofinancial stability,[5] there is little agreement on what the 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 favour other options?

This paper addresses both of these issues by exploring several questions about past credit booms and busts: What indicators are useful in predicting 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?

The findings reported here show that credit booms are often associated with financial reform and economic growth. Fixed exchange rate regimes, weak banking supervision and loose macroeconomic policies are more conducive to booms. One in three credit boom episodes are followed by a crisis. The larger and the longer is a boom, the more likely that it ends up badly. Monetary and fiscal policies do not appear to be effective in

[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 et al. (2005), Boissay et al. (2006), Cottarelli et al. (2003), Duenwald et al. (2005), Hilbers et al. (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.

[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.

[5] 'Macrofinancial stability' refers to the strong macro-financial linkages in modern economies and the resulting interdependence between macroeconomic and financial stability.

limiting booms. Macroprudential tools, in contrast, have at times proven effective in containing booms, and more often in limiting the consequences of busts, due to the buffers they helped to build.

The analysis here contributes to the literature by providing an all-round analysis of credit booms. Several studies have analysed specific aspects (e.g. association with financial distress, capital flows, etc.) of this phenomenon but, to the best of our knowledge, this is the first comprehensive look at incidences of (bad) credit booms and the role of policies in mitigating booms. On the latter, while recent research on macroprudential policies have explored their effectiveness in the context of systemic risks associated with credit booms, we go beyond and discuss all macro policies (the finding on the relative ineffectiveness of monetary and fiscal policies, to the best of our knowledge, is new in the literature). We do so using a large cross-country dataset covering 170 countries over the period 1970–2010 (176 credit boom episodes). Use of a rather comprehensive dataset complements the recent literature that includes historical analyses of long-time series in a limited number of countries (e.g. Jordà et al., 2011) and analyses utilizing micro-level data (e.g. Dell'Ariccia et al., 2012).[6] The paper thus serves as a useful reference point for researchers and policy-makers interested in the topic.

We proceed as follows. Section 2 proposes a methodology for measuring credit booms and presents some stylized facts on the characteristics of credit booms. Section 3 assesses the conditions that may be more conducive to credit booms. Section 4 analyses the characteristics of booms that end up in busts or crises. Section 5 discusses the implications for policy-makers dealing with credit booms. Section 6 concludes.

2. 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, non-bank financial intermediaries, trade credit, informal finance and so on). And future booms in these markets may prove as dangerous as those in bank credit. However, data availability makes a cross-country analysis of these alternative sources of funding difficult and with a few exceptions (notably the United States), bank credit accounts for an overwhelming share of total credit.[7] Hence, we are confident that we are capturing the vast majority of macro-relevant episodes. Second, we confine our attention to countries with

[6] Studies in each category have their strengths and shortcomings: large cross-country studies such as ours help shed light on common patterns but often cannot establish causal evidence; historical analyses provide insights into long-term trends and consequences but suffer from structural breaks in the economy and/or the financial system; micro-level analyses can disentangle supply and demand, identify the mechanisms at play, and establish causality but can be difficult to translate to aggregate outcomes and policies.

[7] Based on the World Bank's domestic credit to private sector series, banks provide, on average, 94% of the credit. The ratio is 45% for the United States but exceeds 60% for all other countries.

credit-to-GDP ratios above 10%. 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.[8]

We are interested in episodes that can be characterized as 'extraordinary' positive deviations in the relationship between developments in 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 discussion (Gourinchas et al., 2001; Mendoza and Terrones, 2008; Barajas et al., 2008; Jordà et al., 2011; Mitra et al., 2011; Claessens et al., 2012). Most methodologies in the literature compare a country's credit-to-GDP ratio to its non-linear 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. Fortunately, the set of booms identified using different methods is rather robust (see Appendix 1 for a comparison to other methodologies).

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 policy-makers in real time. This contrasts with methodologies that use the entire time series to detect deviations from trend (e.g. 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 et al., 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 provided in Appendix 1.)

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

[8] Dropping the cases in which the credit-to-GDP ratio is less than 10% is common practice in the literature. The reason for the practice is two-fold. First, the data series tend to be less smooth, making it difficult to distinguish between trend-growth and abnormal growth episodes. Second, financial deepening is more likely to be the main driver of rapid credit expansion episodes in such financially underdeveloped economies. For more on the latter, see Beck et al. (2010), who use credit to GDP as an indicator of financial deepening and examine how financial deepening vary across income groups over time.

either of the following two conditions is satisfied: (1) 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%; or (2) the annual growth rate of the credit-to-GDP ratio exceeds 20%. 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.[9]

2.1 Sample and stylized facts

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 176 credit boom episodes for our sample period 1970–2010.[10] This translates into an 11% probability of a country experiencing a credit boom in a given year.[11] 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% 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 (28% 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. Since the global financial crisis erupted, the frequency of credit booms came down as global banks deleveraged.
- Most booms happen in middle-income countries (both in absolute and relative terms). This is consistent with the view that, at least in part, credit booms are

[9] Undoubtedly, there are some challenges in making this definition a timely indicator. In particular, GDP data becomes available with significant delay and is subject to significant revisions. To make a better-informed judgement call in real time, policy-makers can use higher-frequency indicators (e.g. spreads, number of loan applications) and micro data (e.g. loan registries).

[10] Data are available, at the time of the dataset construction, up to 2013; we do not use the additional three years in the empirical analysis because the timing does not allow us to determine the outcome (i.e. whether the boom has ended badly or not). The parts of the analysis where the incidence rather than the outcome of the boom is the focus are robust to including these three additional years. The number of countries reported, 170, is before the 10% threshold applied so that we do not exclude the cases where the credit-to-GDP ratio started from a very low level and rapidly exceeded the threshold later in the sample period. See Appendix 1 for a full list of countries in the sample and the booms identified.

[11] 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.

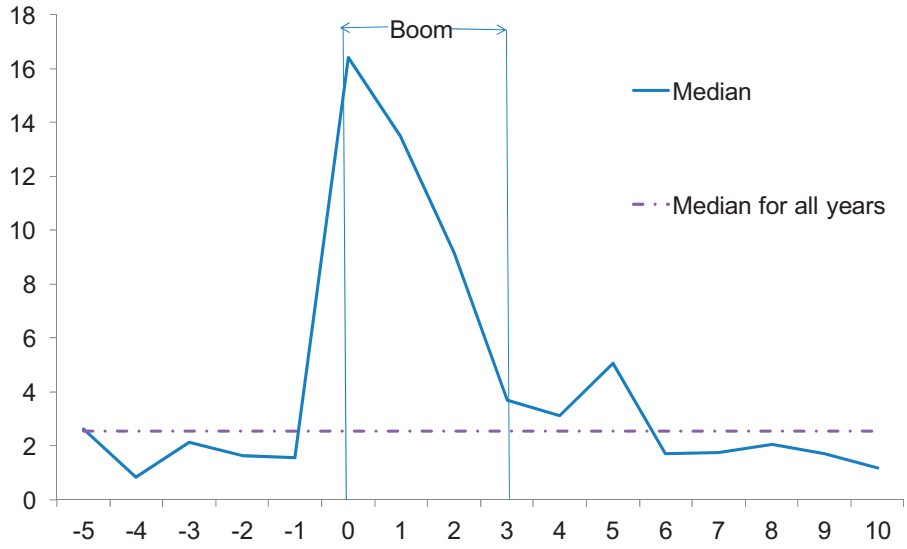

Figure 1. A typical credit boom (Growth rate of credit-to-GDP ratio around boom episodes)

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

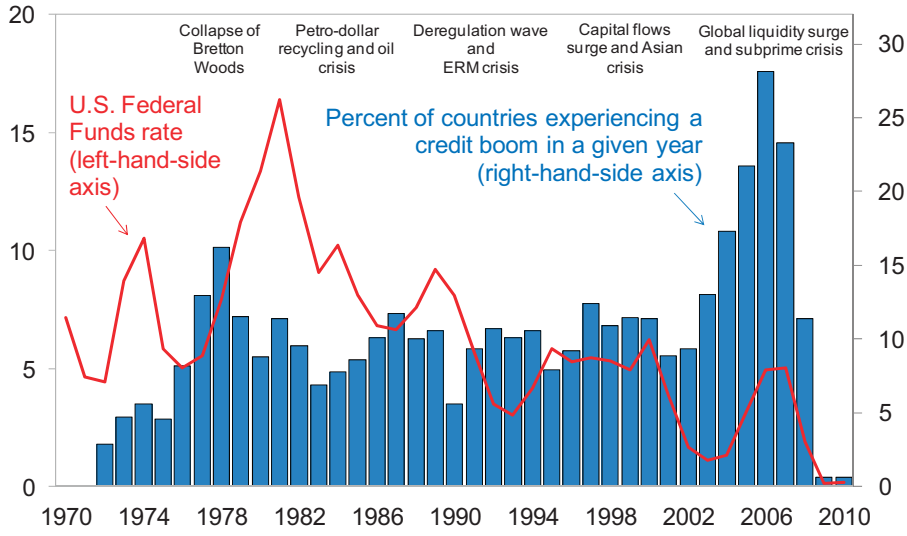

Figure 2. Concurrence of credit booms, 1970–2010

Sources: Board of Governors of the Federal Reserve System, IMF *International Financial Statistics;* staff calculations.

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 average credit-to-GDP ratio at the start of a boom is 31%, compared to an average credit-to-GDP ratio of 37% 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 Latin America and Sub-Saharan Africa. 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 fuelled 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.

2.2 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 roughly 2.1 percentage points, on average.[12] Private consumption expands faster during booms. But it is private investment that picks up markedly, with the average growth rate 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.[13]

The increase in consumption and investment associated with credit booms is often more pronounced in the non-tradable 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 may be building up through the external sector. Indeed, during a boom the current account deteriorates, on average, by almost 3 percentage points of GDP. Most

[12] 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.

[13] See Mendoza and Terrones (2008), Igan and Pinheiro (2011) and Mitra et al. (2011) for more on the behaviour 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.

Table 1. Economic performance

	All years	
	Non-boom years	Booms
Average change in		
Credit-to-GDP	1.6	16.6
GDP	3.3	5.4
Consumption	4.0	5.4
Investment	5.0	10.5
Equity prices	4.3	11.1
House prices	1.2	9.5

Notes: Average across all credit boom episodes. Average annual changes expressed in per cent. The differences between non-boom years and booms are statistically significant at conventional levels.

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 et al., 2012; and Igan et al., 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 triple the rate in real terms. House prices, on average, grow at an annual rate of around 1% in non-boom years but accelerate sharply during booms to a growth rate of 10%. This synchronization with asset price booms may create balance sheet vulnerabilities for the financial and non-financial sectors, with repercussions for the broader economy.

2.3 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; Beck et al., 2000; Favara, 2003).[14] Moreover, the economic magnitude of this effect is substantial: increasing financial depth (measured by M2-to-GDP ratio) from 20% to 60% would increase output growth by 1% a year (Terrones, 2004).

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

[14] 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).

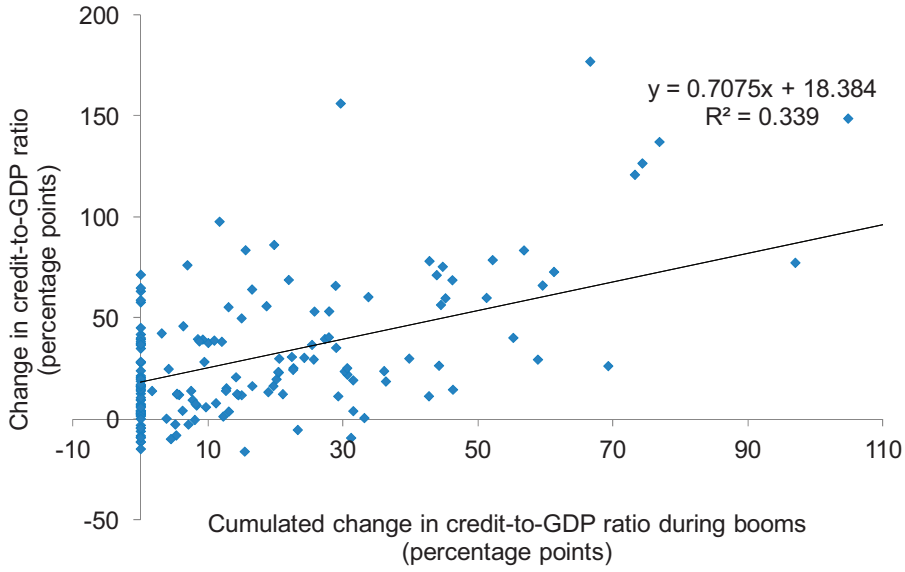

Figure 3. Credit booms and financial deepening, 1970–2010

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

financial deepening resulting from a sharp increase in credit is equivalent to a 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% 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 et al., 2008).

2.4 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 undeserved bad reputation due

Table 2. Long-term growth and credit booms

Years spent in a boom	Change in real per capita income	
	Mean (%)	Median (%)
None	50	49
Between 1 and 5	62	64
More than 5	68	71

Table 3. Credit booms gone wrong

Followed by financial crisis?	Followed by economic underperformance?					
	No		Yes		Total	
	Number	Per cent of total cases	Number	Per cent of total cases	Number	Per cent of total cases
No	52	30	67	38	119	68
Yes	14	8	43	24	57	32
Total	66	38	110	63	176	

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.

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 et al., 2011; Gourinchas and Obstfeld, 2012). In our sample, about one in three booms is followed by a banking crisis (as defined in Laeven and Valencia, 2010; and Caprio et al., 2005) within three years of its end (Table 3).[15]

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 US 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 et al., 2012). In 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 et al., 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),

[15] 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 Appendix 1 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.

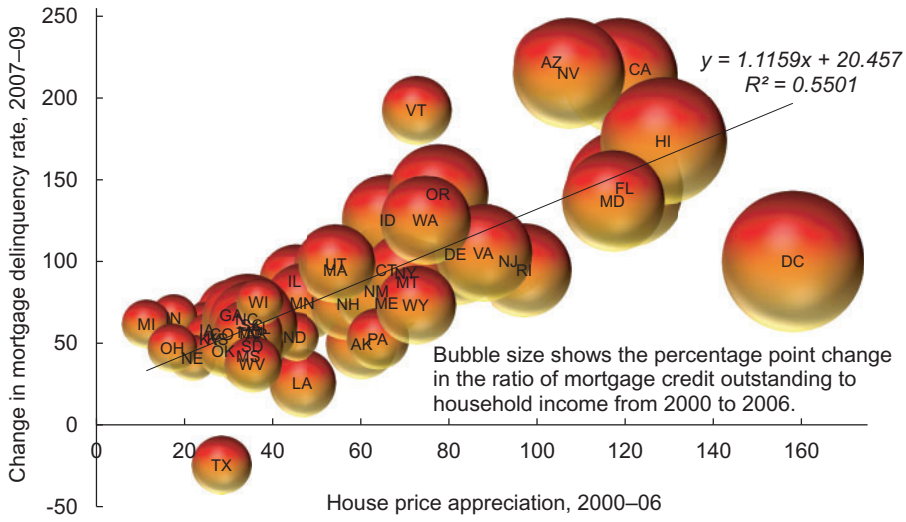

Figure 4. Leverage: linking booms to defaults

Sources: Federal Housing Finance Agency, Mortgage Bankers Association, Bureau of Economic Analysis, US Census Bureau.

Note: Each data point corresponds to a US state, indicated by the two-letter abbreviations.

and Korea, Malaysia, Philippines and Thailand (1997–98) (Figure 5). And going further back, the Great Depression has also been cast as a credit boom gone wrong (Eichengreen and Mitchener, 2003).[16]

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 (Table 3). During these below-trend periods, annual economic growth was on average 2.1 percentage points lower than in 'normal' times (excluding booms). 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 (124 out of 176 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).[17] This is consistent with the view that credit booms leave

[16] Credit booms are generally associated with banking crises rather than other types of crises. For comparison, 15% of the booms in our sample were followed by a currency crisis and 8% 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 et al., 2011; Leigh et al., 2012).

[17] The extraordinary experience of the Baltic countries and Ireland may seem to be driving this finding (note that Iceland, which had a similar but even larger boom-bust episode–is already excluded in the figure as an outlier). But this correlation, albeit weaker, holds for the rest of the episodes as well.

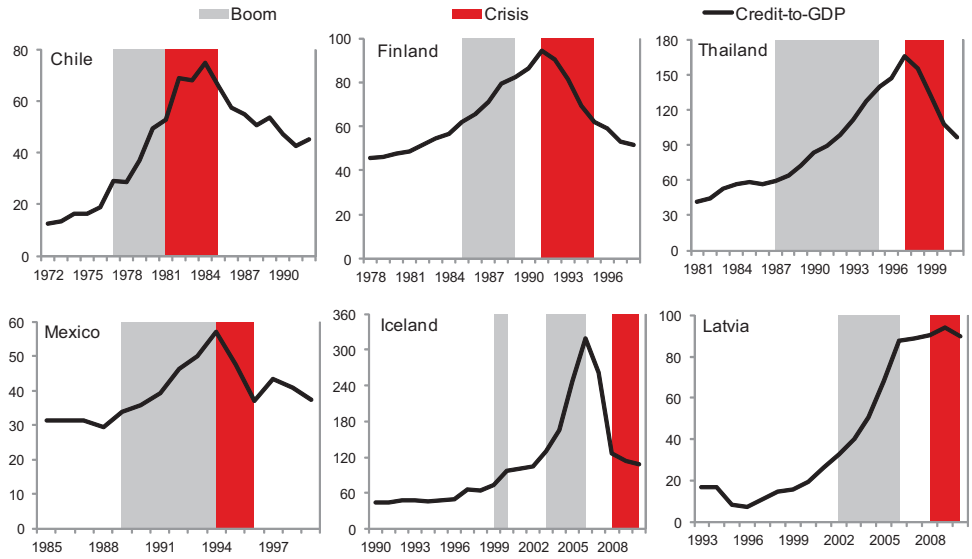

Figure 5. Credit booms and financial crises: examples of bad booms

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

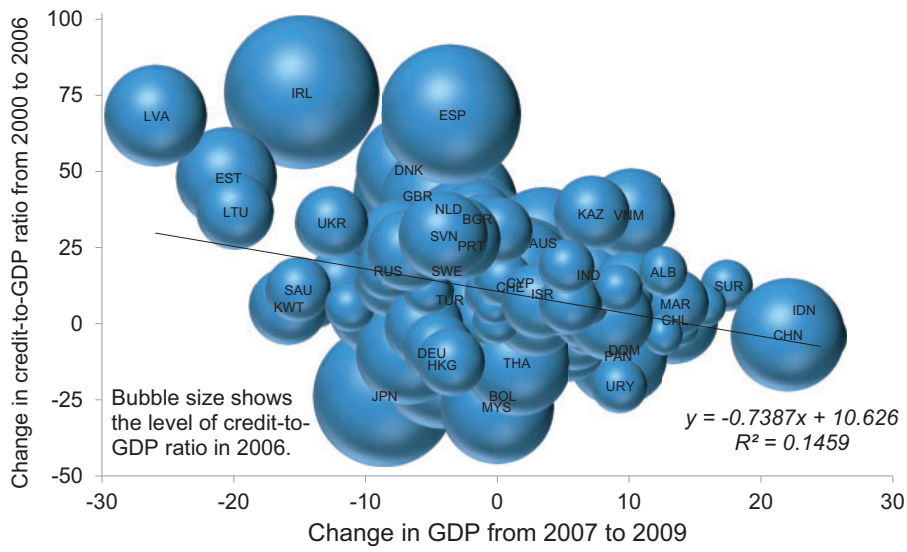

Figure 6. Credit growth and depth of recession

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

Note: Each data point corresponds to a country, indicated by the three-letter abbreviations.

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 et al., 2011). Industries that are dependent on external finance and financing-sensitive activities (e.g. investment) appear to suffer more during creditless recoveries, potentially indicating that resources may be allocated inefficiently across industries and activities.

3. WHEN DO CREDIT BOOMS HAPPEN?

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, based on the literature and the empirical regularities in our dataset: the 'predictors' of credit booms. Identifying these predictors could help gauge a country's susceptibility to credit booms and devise policies to reduce it.

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 et al., 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% 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: 16% of liberalizations are linked to credit booms, compared with 6% 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 two-year period prior to the start of a credit boom, increasing from 1.7% of GDP to 2.4% of GDP, on average.

Third, credit booms generally start during or after buoyant economic growth.[18] More formally, lagged GDP growth is positively associated with the probability of a credit boom: in the two-year period preceding a boom, the average real GDP growth rate reaches 4.4%, compared to 3.6% in an average tranquil three-year period.

[18] 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 nineteenth 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).

These factors may emerge 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 US federal funds rate;[19] see Figure 2) and, thus, are correlated across countries. Trade and the transmission of technological advances across borders tend to synchronize 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 towards maintaining a fixed exchange rate and is therefore unable to respond effectively to the build-up 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. Prolonged loose monetary policy, in particular, reduces the cost of borrowing and boosts asset price valuations, which in turn can trigger credit booms. 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.

The discussion and the empirical regularities presented so far are in a univariate framework, which has several shortcomings. In particular, not controlling for all relevant variables may generate spurious correlations. In Table 5, we examine in a multivariate regression framework the association between the various macroeconomic and structural indicators and the likelihood of credit boom episodes. Specifically, we estimate the following regression equation:

$$(\text{Boom} = 1)_{it} = \alpha + \beta \mathrm{X}'_{it} + \varepsilon_{it},$$

where X is a vector of macroeconomic indicators and structural variables. We focus on the boom episodes we have identified and compute the values of these variables as the average of their values one year before the start of the boom and during the first year of the boom. If the number of boom episodes in a country is more than one, we treat all boom episodes as a single observation and take the average across those episodes. For the non-boom observations, explanatory variables are calculated as the average for the sample period of no booms. Hence, we have a dataset composed of observations that

[19] See Borio et al. (2011) on the role of global conditions in the context of credit booms.

Table 4. Economic and financial policy frameworks and credit booms

(frequency distribution, in per cent)

	Exchange rate regime		Monetary policy		Fiscal policy		Banking supervision	
	Fixed	Floating	Loose	Tight	Loose	Tight	Low	High
1970–1979	11.0	5.5	7.1	8.6	14.5	5.5	14.8	1.1
1980–1989	11.0	9.1	16.4	2.1	20.0	7.3	22.2	0.6
1990–1999	22.6	4.3	25.0	0.0	26.4	8.2	24.4	2.3
2000–2009	26.2	10.4	35.7	5.0	12.7	5.5	18.8	15.9
All years	70.7	29.3	84.3	15.7	73.6	26.4	80.1	19.9

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% (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% of GDP (the top quartile). Banking supervision quality measure is from Abiad et al. (2008).

characterize the circumstances in a country in 'normal times' and at the verge of a boom episode. Following the recent literature and subject to constraints posed by data coverage, we also explore whether certain types of booms are associated with certain conditions. In particular, we distinguish the booms that coincide with house price booms (see, for instance, Crowe et al., 2011) and look separately at booms in the household sector and those at the non-financial corporate sector (see, for instance, Beck et al., 2012). In terms of structural variables, we include trade openness and exchange rate regime as well as an indicator of bank orientation.[20]

We find that GDP growth and financial reform are associated with an increased likelihood of credit booms. This result is pretty robust when we look at aggregate credit as well as when we distinguish between household and firm credit booms. There is some evidence that flexible exchange rate regimes are less likely to be associated with credit booms. We do not find any support for bank-based systems being associated with a greater likelihood of credit booms: if anything, bank orientation seems to be negatively correlated with incidence of booms. Other indicators we include generally have statistically insignificant and/or very small coefficients. Overall, it is difficult to predict credit booms. Regression analysis suggests that the predictors and macroeconomic conditions described above may have some bearing on assessing the susceptibility of a country to a credit boom. But they are far from giving definitive signals: the residual variability is substantial and

[20] Recent literature has shown that bank-based financial systems suffer deeper banking crises (e.g. Langfield and Pagano, 2015). To capture any differences in the incidence of credit booms, we include a dummy indicator for bank-based financial markets in the regressions. That is, we first construct the ratio of bank private credit to the sum of bank private credit and stock market capitalization for each country-year. Based on this ratio, we create a dummy which is one if the ratio is greater than the global median.

Table 5. Regression analysis: incidence of credit booms

Dependent variable: dummy = 1 if there is a boom					
	Credit boom (1)	Credit boom (2)	Credit and house price boom (3)	Household credit boom (4)	Firm credit boom (5)
GDP per capita	−0.045	−0.126	−0.066	−0.042	0.022
	(0.045)	(0.143)	(0.040)	(0.041)	(0.051)
GDP growth	0.038*	0.121*	0.043***		
	(0.020)	(0.064)	(0.013)		
Capital inflow surge	0.033*	0.119**	0.004	0.006	0.010
	(0.017)	(0.054)	(0.017)	(0.017)	(0.019)
Financial reform	0.768**	2.477***	1.314***	1.576***	1.018***
	(0.301)	(0.950)	(0.246)	(0.289)	(0.274)
Inflation	0.006	0.019	−0.013**	−0.000	−0.001
	(0.009)	(0.027)	(0.006)	(0.007)	(0.008)
Current account balance	0.015	0.057*	0.004	0.024**	0.019
	(0.009)	(0.030)	(0.010)	(0.010)	(0.014)
Trade openness	−0.002	−0.005	−0.003***	−0.004***	−0.003***
	(0.001)	(0.004)	(0.001)	(0.001)	(0.001)
Exchange rate regime	−0.028**	−0.091*	−0.019	−0.016	−0.018
	(0.014)	(0.046)	(0.012)	(0.015)	(0.014)
Bank orientation	−0.198*	−0.637*	−0.207*	−0.124	−0.191*
	(0.107)	(0.338)	(0.108)	(0.111)	(0.103)
Consumption growth				0.046***	
				(0.015)	
Investment growth					0.039***
					(0.008)
Observations	123	114	103	115	112
R^2	0.246		0.597	0.473	0.533
Region fixed effects	Yes	Yes	Yes	Yes	Yes
Pseudo R^2		0.178			

Notes: All regressions–except for column (2) which uses probit–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 per cent of GDP. Financial reform is a normalized index, as calculated by Abiad et al. (2008), with higher values indicating a more liberal and standardized regulatory framework. Inflation is the annual percentage growth in CPI. Current account balance is expressed in per cent of GDP. Trade openness is the sum of exports and imports divided by GDP. Exchange rate regime denotes the Reinhart–Rogoff fine classification, with higher values corresponding to more flexibility in exchange rate determination. Bank orientation is a dummy variable that takes the value of 1 if the ratio of bank credit-to-GDP over the sum of bank credit-to-GDP plus stock market capitalization of listed companies as a percentage of GDP is greater than the median of the ratio across first year boom observations. Consumption growth is the annual growth rate of real consumption. Investment growth is the annual rate growth of real investment. All variables except the categorical ones are winsorized at the 5% level. For the boom observations (where dummy = 1), all explanatory variables are calculated as the average of their values one year before the start of the boom and during the first year of the boom (if the number of boom episodes in a country is more than one, we treat all boom episodes as a single observation and take the average across those episodes). For the non-boom observations (where dummy = 0), explanatory variables are calculated as the average for the sample period of no booms. Columns (1) and (2) use credit boom as the dependent variable, column (3) uses a dummy = 1 if there was a credit boom and a house price boom, column (4) uses a dummy = 1 if there was a household credit boom, and column (5) uses a dummy = 1 if there was a firm credit boom. The sample period is 1970–2010. Robust standard errors clustered at the country level are in brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

identifying causality is problematic (for more on challenges posed by omitted variables and endogeneity in our setup, see Section 5).

4. CAN WE TELL BAD FROM GOOD CREDIT BOOMS?

The analysis in the previous sections implies that policy-makers 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 (1) followed by a banking crisis within three years of its end date, or (2) associated with a recession or an inferior (below-trend) medium-term growth performance.[21]

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, e.g., 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 regional fixed effects and various country characteristics. Given that a boom is in place, the probability of its turning bad is modelled as:

$$(\text{Bad boom} = 1)_{it} = \alpha + \beta X'_{it} + \gamma P'_{it} + \varepsilon_{it},$$

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, based on the comparative statistics and the regression analysis, we find that:

- '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.

[21] 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 (1) and (2) overlap: in 43 out of 57, or 75%, of the cases in which there is a crisis, growth stalls (see Table 3).

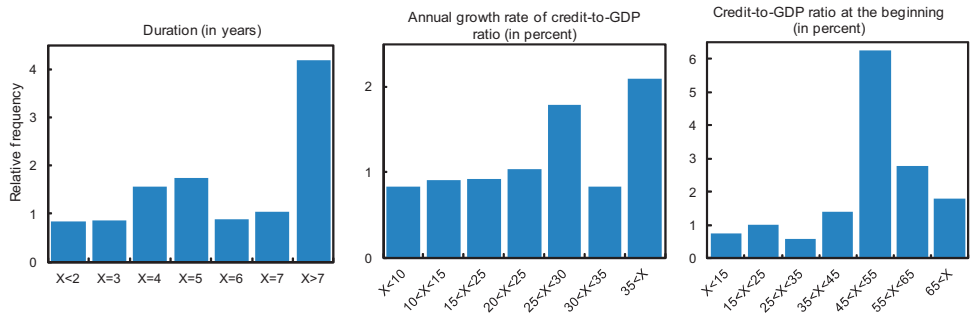

Figure 7. Bad versus good booms

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.

- In a multivariate setup, the associations are more challenging to pin down with statistical significance and signs of the coefficients showing little sign of robustness.

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 et al., 2001; Barajas et al., 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.[22] 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.[23]

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 et al., 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 et al., 2011) lose significance once we condition for the presence of a credit boom (as measured in this paper). Indeed, in our sample,

[22] This is based on a regression analysis using the specifications in Table 5 (see Section 3) with bad boom dummy as the dependent variable. The results are not included for the sake of brevity but are available from the authors upon request.

[23] 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% of the booms happening in emerging markets are followed by a crisis within three years after the boom ends, while the ratio is 57% for advanced economies.

while asset prices grow much faster during booms than in tranquil times (e.g. for equity prices about 11% versus 4% a year), they grow at about the same pace during both bad and good booms (again, for equity prices, about 11% 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% of the average annual growth (11 out of 26), or started at an initial credit-to-GDP ratio higher than 50% (14 out of 25) ended up in crises. These regularities (see also Mitra et al., 2011; and Borio et al., 2011) can guide policy-makers in weighing the benefits and costs of an ongoing boom and in setting thresholds that would trigger policy action. In addition, investment in gathering micro data can improve the ability to detect bad booms in real time (e.g. Jiménez et al., 2014; Freixas et al., 2015).

5. WHAT ARE THE IMPLICATIONS FOR POLICY-MAKERS?

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 crisis, but their associated leverage build-ups have a long-lasting impact on corporate and household behaviour, 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 and, hence, cause booms to turn bad. 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 et al., 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 et al., 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

by several observers as vestiges from the past and played a debatable role in actual policy setting.[24]

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 et al., 2011). Other emerging markets experimented with applying prudential rules to counteract credit and asset-price cycles (Appendix 2).

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, 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 what friction they would be able to address in theory, their pros and cons, summarized in Appendix 2, in the light of the experiences of various countries and available empirical evidence. We examine what policies, if any, have been associated with success 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 when they are added in the econometric specification described in the previous section.

One concern is that policies may respond endogenously to the incidence of credit booms. This is particularly relevant for macroprudential regulations that are intended to manage the dangers associated with credit booms. In our empirical analysis of the incidence of credit booms, we therefore use either lagged or initial values of all explanatory variables. More specifically, for the boom observations, we compute all explanatory variables (including the policy variables) as the average of their values one year before the start of the boom and during the first year of the boom (if the number of boom episodes in a country is more than one, we treat all boom episodes as a single observation and take the average across those episodes). For the non-boom observations, explanatory variables are calculated as the average for the sample period of no booms. In the analysis on the determinants of 'bad' booms, i.e., booms that end up in crises, we also lag the explanatory variables. Specifically, macroprudential policy is set equal to the value of

[24] 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 et al., 2006).

the macroprudential variable in the year before the start of the boom, while all other policy variables (fiscal and monetary policy) are computed as averages over the boom years. This mitigates, but not eliminates, concerns about policy endogeneity.

5.1 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 et al., 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, e.g., 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. Those that float might be concerned about large exchange rate swings potentially 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.

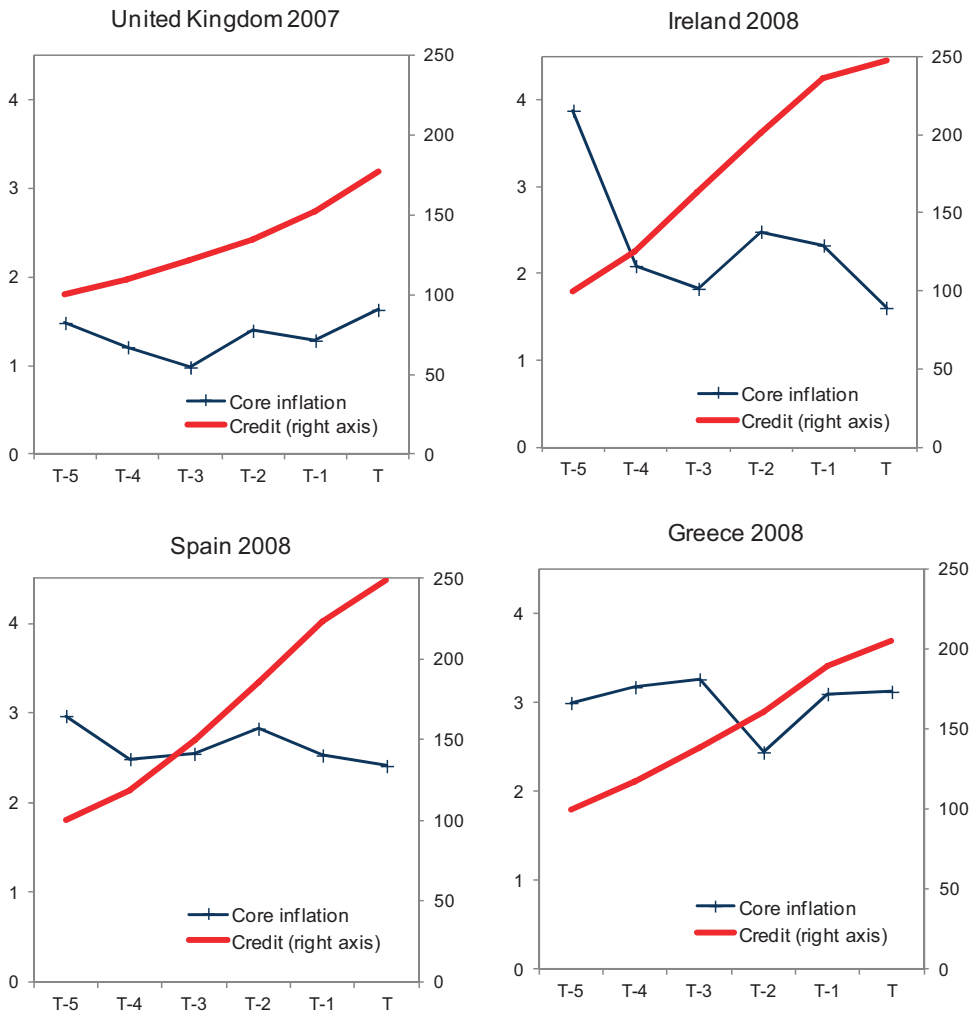

Figure 8. Credit growth and monetary policy (Selected countries that had a boom in the run-up and a crisis in 2007–8)

Sources: IMF *International Financial Statistics*, World Economic Outlook, Global Data Source; staff calculations.

Notes: Credit is indexed with a base value of 100 five years prior to the crisis.

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 et al., 2008).

In line with these concerns, we find little evidence in support of the view that tighter monetary conditions (measured as deviations from a simple Taylor-rule-like equation)

Table 6. Regression analysis: incidence of credit booms and policies

Dependent variable: dummy = 1 if there is a credit boom

	(1)	(2)	(3)	(4)
GDP per capita	−0.038	−0.063	−0.161***	−0.173***
	(0.047)	(0.042)	(0.051)	(0.049)
GDP growth	0.036*	0.025	0.059***	0.051***
	(0.020)	(0.020)	(0.016)	(0.017)
Capital inflow surge	0.032*	0.038*	0.030*	0.033*
	(0.018)	(0.020)	(0.016)	(0.019)
Financial reform	0.639*	0.654**	0.906***	0.613**
	(0.353)	(0.305)	(0.275)	(0.302)
Inflation	0.005	0.001	0.004	−0.001
	(0.009)	(0.009)	(0.008)	(0.008)
Current account balance	0.013	0.011	0.021***	0.016
	(0.010)	(0.012)	(0.008)	(0.011)
Trade openness	−0.001	−0.002	−0.002**	−0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Exchange rate regime	−0.025*	−0.024	−0.013	0.002
	(0.014)	(0.016)	(0.013)	(0.016)
Bank orientation	−0.201*	−0.301***	−0.300***	−0.406***
	(0.108)	(0.108)	(0.098)	(0.100)
Monetary policy stance	−0.001			−0.001
	(0.001)			(0.001)
Fiscal policy stance		0.082*		0.097**
		(0.049)		(0.043)
Macroprudential policies			−0.141***	−0.145***
			(0.022)	(0.022)
Observations	123	117	123	117
R^2	0.254	0.292	0.381	0.426
Region fixed effects	Yes	Yes	Yes	Yes

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 per cent of GDP. Financial reform is a normalized index, as calculated by Abiad et al. (2008), with higher values indicating a more liberal and standardized regulatory framework. Inflation is the annual percentage growth in CPI. Current account balance is expressed in per cent of GDP. Trade openness is the sum of exports and imports divided by GDP. Exchange rate regime denotes the Reinhart–Rogoff fine classification, with higher values corresponding to more flexibility in exchange rate determination. Bank orientation is a dummy variable that takes the value of 1 if the ratio of bank credit-to-GDP over the sum of bank credit-to-GDP plus stock market capitalization of listed companies as a percentage of GDP is greater than the median of the ratio across first year boom observations. Monetary policy stance is calculated as the percentage deviation 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 surplus in per cent of GDP deviates from its predicted level based on a simple regression of the surplus on real GDP growth. Macroprudential policies are 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% level. For the boom observations (where dummy = 1), all explanatory variables are calculated as the average of their values one year before the start of the boom and during the first year of the boom (if the number of boom episodes in a country is more than one, we treat all boom episodes as a single observation and take the average across those episodes). For the non-boom observations (where dummy = 0), explanatory variables are calculated as the average for the sample period of no booms. The sample period is 1970–2010. Robust standard errors clustered at the country level are in brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

lower the frequency of credit booms (Table 6). The regression coefficient has the expected negative sign, but is never significant. Furthermore, tighter monetary policy does not seem to reduce the probability that a boom already in place would end up badly either (Table 7).[25] 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; Dell'Ariccia et al., 2014; Jiménez et al., 2014; Ioannidou et al., 2015).

These regressions may underestimate the effectiveness of monetary policy. This may be because the sample contains both fixed exchange rate regimes (where using monetary policy is not an option) and flexible exchange rate regimes, although excluding the former from the sample does not yield significant results. Underestimation could also reflect an endogeneity problem (although, lagging the explanatory variables should assuage this concern): 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.

That said, our results are consistent with country case studies, which, in general, 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 (e.g. Hungary and Poland), shifts to foreign currency-denominated lending were observed (Brzoza-Brzezina et al., 2010).[26]

Countries that allowed their exchange rates to appreciate more freely (e.g. 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 (e.g. Crowe et al., 2011, and references therein).[27] However, there is an emerging consensus that the degree of

[25] 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. In contrast, they find the strength of prudential policies was important in containing these booms.

[26] This is also consistent with the evidence presented in Ongena et al. (2015), who find using loan-level Hungarian data that loose domestic monetary policy leads to more credit initiation in the domestic currency but not in the foreign currency. Put differently, the bank lending channel of domestic monetary policy loses its potency when it comes to the supply of credit in the foreign currency.

[27] Long-time series data on mortgage (or household) credit and house prices for a large number of the countries in our sample are not available. Hence, we do not include them in the regression analysis here. For a smaller set of countries, several studies have shown that the type of credit matters for booms, crises and economic growth (see, for instance, Büyükkarabacak and Valev, 2010; Beck et al., 2012; Bertay et al., 2015).

Table 7. Regression analysis: probability of credit booms from going wrong and policies

	DV: Dummy = 1 if bad				DV: Dummy = 1 if banking crisis				DV: Dummy = 1 if economic performance			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Duration	0.051*	0.038	0.089*	0.089	0.009	0.007	0.034	0.046	0.051*	0.030	0.089*	0.089
	(0.030)	(0.035)	(0.046)	(0.070)	(0.025)	(0.032)	(0.024)	(0.039)	(0.029)	(0.034)	(0.045)	(0.070)
Initial credit-to-GDP	−0.000	−0.001	0.000	−0.000	0.003	0.003	0.004**	0.003	−0.000	−0.001	0.000	−0.000
	(0.001)	(0.002)	(0.002)	(0.005)	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)	(0.003)	(0.002)	(0.005)
Years of low rate	−0.003	0.108	−0.036	0.014	0.035	−0.005	0.028	−0.055	−0.016	0.105	0.045	0.014
	(0.096)	(0.115)	(0.092)	(0.292)	(0.105)	(0.128)	(0.094)	(0.243)	(0.104)	(0.133)	(0.117)	(0.292)
Monetary policy stance (lagged)	0.000			0.002	0.000			0.002**	0.000			0.002
	(0.001)			(0.001)	(0.001)			(0.001)	(0.001)			(0.001)
Fiscal policy stance (lagged)		0.005		0.002		0.021		−0.010		−0.003		0.002
		(0.016)		(0.032)		(0.016)		(0.027)		(0.018)		(0.032)
Macroprudential policies (lagged)			−0.027	0.043			−0.039*	−0.003			−0.021	0.043
			(0.025)	(0.054)			(0.020)	(0.044)			(0.025)	(0.054)
Observations	129	89	73	39	129	89	73	39	129	89	73	39
R^2	0.103	0.070	0.194	0.262	0.107	0.157	0.268	0.268	0.100	0.062	0.174	0.262
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

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. Initial credit-to-GDP is the value of the bank credit-to-GDP ratio at the start year of the boom episode. Years of low rate is the number of years (in logs) in which the policy rate is below the predicted policy rate. Monetary policy stance is calculated as the percentage deviation 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 surplus in per cent of GDP deviates from its predicted level based on a simple regression of the surplus on real GDP growth. Macroprudential policies are the count of macroprudential tools such as reserve and liquidity requirements, foreign exchange open position limits or interest rate controls. For all policy variables, the value in the year before the start of the boom is taken. The sample consists of boom episodes only and each boom episode is treated as a separate observation. The sample period is 1970–2010. Robust standard errors clustered at the country level are in brackets. ***, ** and * denote significance at the 1%, 5% and 10% levels, respectively.

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 tool for intervention to contain a credit boom. In practice, however, there are constraints that limit its effect. 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.

5.2 Fiscal policy

Both cyclical and structural elements of the fiscal policy framework may play a role in curbing credit market developments. Most importantly, a prudent and countercyclical fiscal stance 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% of GDP over the life of the boom would be actuarially fair (the number would drop to about 3% of GDP if based on net costs).[28]

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.

Our empirical results support these considerations. A tighter fiscal policy (computed as the error term by which the general government surplus in per cent of GDP deviates from its predicted level based on a simple regression of the surplus on real GDP growth)

[28] The average gross fiscal cost of systemic banking crises–defined as the component of gross fiscal outlays related to the restructuring of the financial sector including those associated with bank recapitalizations but excluding asset purchases and direct liquidity assistance from the treasury–is estimated to be about 15% of GDP (Laeven and Valencia, 2010). Multiplying this with the probability of a banking crisis following a credit boom (32%) gives 5%. In net terms, i.e., after accounting for the financial gains on government investment in bank equity, average fiscal cost drops to 10% of GDP and, hence, the actuarial fiscal buffer to 3% of GDP. 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.

is associated with higher (rather than lower) incidence of credit booms (Table 6). This perhaps reflects unexpectedly high tax revenues associated with buoyant economic growth during the boom years or reversed causality: the possibility that fiscal policy is tightened in response to the credit boom. Further, a tighter fiscal stance is not statistically significantly associated with a lower probability of a boom ending badly (Table 7).

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 et al., 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 expansion of individual financial institutions, preventing them from becoming 'too systemically important to fail'. The associated revenues could be used to build 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 non-bank 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 piggyback 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 macro overheating and create room to provide stimulus and financial support if and when the bust comes, its effectiveness in directly dealing with credit booms may be limited. The newer proposals advocating 'financial taxation' make sense on paper, but remain to be tested.

5.3 Macroprudential regulation

So far, the empirical analysis and the case studies suggest that the effectiveness of macroeconomic policies in curbing credit booms is questionable. 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 system-wide financial risks. In a strict or narrow sense, they include prudential tools and regulation to address externalities in the financial system (BIS, 2011; and IMF, 2011a). Often, this translates into a focus on creating buffers in financial institutions to internalize their contribution to systemic risk and ensure their solvency when faced with shocks. In a broader sense, however, the objective of macroprudential policies is to smooth financial and credit cycles in order to prevent systemic crises as much as it is to 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:[29]

- 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 aim at making lending more expensive and build buffers, 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 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 their average quality. Examples include loan-to-value (LTV) and debt-to-income (DTI) limits. 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.

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

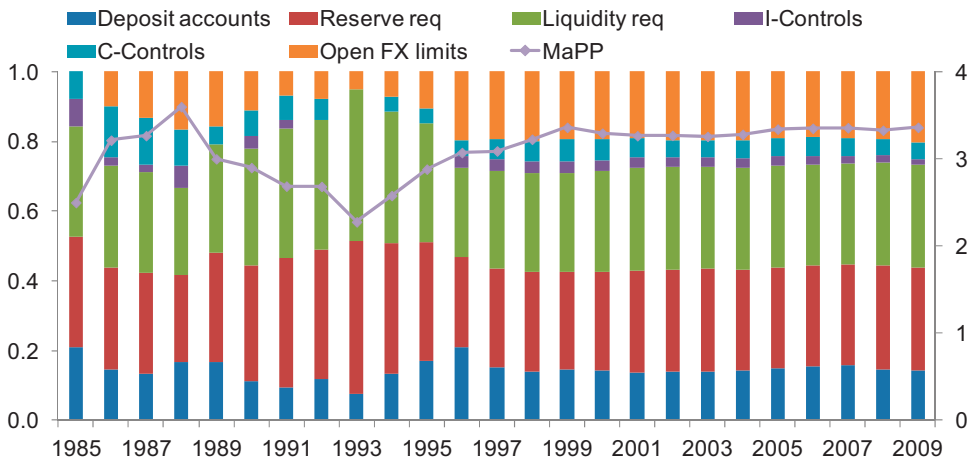

Figure 9. Macroprudential index and its components

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.

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.[30] We compile information on these measures from various issues

[30] 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.

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).[31] The identified measures have been used more intensely over time since the mid-1990s (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 6 and 7).[32] Consistent with the focus of macroprudential tools on financial sector vulnerabilities, the association with a reduction in the probability of a bad boom is found primarily for booms that end up in a financial crisis (Table 7).[33] This suggests that macroprudential policy can reduce the risk of a bust while simultaneously reducing the vulnerability of the rest of the economy to troubles in the financial system.[34] These findings are in line with those in Lim et al. (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. Similarly, Cerutti et al. (2015) report that usage of macroprudential tools is generally associated with lower growth in 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 et al., 2011). Likewise, Peru's reserve requirements on deposits in 2008 helped contain the risks posed by rapid credit growth while shielding the inflation targeting

[31] 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).

[32] 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.

[33] The results in Table 7 are robust to alternative specifications where other control variables (such as bank orientation and banking supervision quality) are also included.

[34] 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.

framework (Terrier et al., 2011). Dynamic loan-loss provisioning rules introduced in Spain in 2000 allowed Spanish banks to better absorb negative shocks and maintain exposures during the crisis. In this way, they worked in their intended countercyclical fashion (Jiménez et al., 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%), 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% in 2002 to 11.8% in 2003), since the penalty for breaching the rule was high. However, the growth of total domestic credit (including credit from non-banks) barely declined, as banks circumvented the rule by booking loans directly on their foreign parent banks and by lending to the private sector through their non-bank (e.g. leasing company) subsidiaries (Kraft and Galac, 2011). This contributed to the build-up of systemic risk in the non-bank 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 et al., 2012). 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 et al., 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. However, more time and analysis are needed for a full assessment of their effectiveness. Their targeted nature entails a more favourable cost-benefit balance. Yet a potential problem with their targeted nature is that it makes these instruments more

susceptible to circumvention and political resistance.[35] 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, 2009). Another potential issue is whether one can separate the procyclical dimension of credit from its cross-sectional dimension (Horváth and Wagner, 2014). Providing insurance against aggregate fluctuations may increase incentives to take on more risks on the latter dimension, with potentially adverse consequences because of the increased common exposures and probability of joint distress.

6. CONCLUSIONS

Prolonged credit booms are a harbinger of financial crises and have real costs. Our analysis shows that, while only a (significant) 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 (at least based on macro data alone), 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 raises 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

[35] Indeed, Cerutti et al. (2015) find that effects of macroprudential tools are less in financially more developed and open economies, suggesting some circumvention. Turning to political resistance, the evidence presented in this paper suggests that the benefits and costs of credit booms materialize over different time horizons. This opens the question of institutional aspects of macroprudential policy–it may be necessary to give the control of these tools to an agency that is shielded from short-term pressures or use rules rather than discretion in their implementation (see, e.g., Nier et al., 2011, for more). A related question is how macroprudential and monetary policies interact. Bruno et al. (2015), for instance, find that macroprudential policies are more successful when they complement monetary policy by reinforcing monetary tightening. This suggests an important role for the central bank–an agency often independent and immune from political pressures–in the conduct of macroprudential policies.

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. 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 policy-makers 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.

Discussion

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Sciences Po and CEPR

The paper provides a very nice anatomy of credit booms and busts looking at a large cross-section of 170 countries over the period 1970–2010. We learn a lot from this paper which provides important stylized facts regarding the occurrence of credit booms. The paper is particularly relevant since credit booms have been found in the literature as major determinants of financial crises (see, among others, Kaminsky and Reinhardt

(1999) for earlier work, Gourinchas and Obstfeld (2012) for more recent evidence). Understanding better credit booms is thus essential for a better understanding of financial crises. This is where stands the contribution of the paper by Dell'Ariccia, Igan, Laeven and Tong.

The paper essentially tackles three important questions:

Q1–When do credit booms occur?
Q2–When do they end up in busts?
Q3–What are the implications for different policies if curbing credit growth and/or mitigating the associated risks is an objective?

To answer those crucial questions, the authors built a dataset of credit booms ('good' and 'bad') across 170 countries over the period 1970–2010. They identify credit booms ('good' and 'bad') and investigate countries' characteristics in the period of booms versus 'tranquil times' in a univariate and multivariate analysis. Finally, they provide insights regarding the role of policies in limiting the occurrence of credit booms–standard stabilization policies (monetary and fiscal) as well as macroprudential policies. Using their dataset, the paper provides a lot of relevant stylized facts for policy-makers. In a nutshell, their main findings can be summarized as follows: faster (past) output growth, financial deepening and less flexible exchange rate regimes are 'robustly' associated with the occurrence of a credit boom. 'Bad' credit booms tend to be larger in magnitude and last longer. Regarding policies, even though the paper cannot really address their effectiveness as discussed below, results suggest that conflicting objectives reduce the ability of standard stabilization policies to deal with credit booms, opening a potentially important role for macroprudential policies.

To discuss their findings, I will follow the order implied by those three questions.

Q1–When do credit booms occur?

Regarding the first question addressed, I have three main comments. First, to my surprise, variables that have been found to be good predictor of financial crises in the literature (Kaminsky and Reinhardt, 1999; Gourinchas and Obstfeld, 2012) are either not considered or do not show up–capital inflows surge, a real exchange rate appreciation, the amount of reserves or short-term debt over GDP. I believe adding more variables will reduce the sample significantly and the authors might quickly run into multicollinearity issues but it is not very clear in the paper how variables are selected in their multivariate framework. Regarding capital flows, it seems that it would be nice to try to disentangle the nature of the flows, namely short-term flows versus long-term, portfolio flows versus FDI, foreign currency denominated inflows. This would allow the authors to link their findings with the earlier theoretical literature on financial and/or currency crises (see Jeanne (2000) for an early survey of the literature on currency crises. See also Glick and Hutchinson (2012)).

Second, as an international macroeconomist, I was particularly interested in their finding regarding the role of exchange rate regimes. This finding calls for further work as one might want to identify the channels through which the rigidity of exchange rates might affect positively the occurrence of booms: is it the loss of the ability to run autonomous monetary policy? Or the inconsistency of fiscal and/or monetary policies with the chosen exchange rate regime–in the tradition of first-generation models of currency crises (Krugman, 1979)? Alternative stories based on exchange rate speculation towards some fixed exchange rate regimes and/or carry-trade strategies by investors could also well be worth investigating.

Third, while finding covariates that are associated with credit booms provide interesting new insights, a related question is whether one can *predict* credit booms in real time–if yes, how much ahead? I believe the latter question is certainly more difficult to deal with but also more interesting from a policy perspective, given the lags involved in implementing the appropriate policies. This might involve a different empirical methodology using panel data across countries but this could be a nice complement to the present study.

Q2–When do they end up in busts?

The authors insist on the statistical nature of 'bad' booms versus 'good' booms. 'Bad' booms, meaning the ones ending in a financial crisis, last typically longer and are of larger magnitude. However, the authors do not discuss so much in a multivariate framework how variables associated with the occurrence of credit booms in the first place are also significantly associated with the occurrence of 'bad' booms. While I understand that 'bad' booms are much less frequent, which raises concerns for statistical inference, it would be important for policy-makers to know whether the variables discovered to answer Q1 are also robustly associated with 'bad' booms. This seems crucial as policies are meant to prevent 'bad' booms while potentially keeping the 'good' ones going. Beyond statistical differences between the two, finding covariates that can help to tell them apart, seems a natural and important extension of the paper.

Q3–What are the implications for different policies if curbing credit growth and/or mitigating the associated risks is an objective?

While the authors are extremely cautious in the interpretation of their empirical results, it seems difficult to infer any conclusion regarding the effectiveness of policies in mitigating the risks associated with credit booms. This is so, in particular, because policies are endogenous to the occurrence of booms. For instance, if monetary policy is autonomous, interest rates tend to be higher in period of credit expansions. High interest rates are thus associated with credit booms and it is impossible with such data to investigate whether higher interest rates limits the occurrence (or the magnitude) of such booms. This is unfortunate and calls for further work to be able to properly infer the causality

from policies to the occurrence of booms. For monetary policy, one direction for future work could be to exploit the impossible trinity of Mundell: countries with fixed exchange rate regime and free capital movements mostly adopt the monetary policy of the country they are pegging their currency to. This generates a monetary stance that is potentially exogenous to the occurrence of booms in those countries. While this is beyond the scope the paper, the present paper has the important virtue to open doors for further research and to raise some crucial questions regarding the ability of policies to deal with credit booms. It has also the merit to generate fruitful thinking regarding the role of macroprudential policies when dealing with credit booms.

Conclusion

To conclude my discussion, I would say that the contribution of the paper by Dell'Ariccia, Igan, Laeven and Tong lies in its very fine description of credit booms and busts across the globe. It provides a set of important stylized facts which clearly opens the door to further research on the matter, whether from an empirical or theoretical perspective. It is also a very relevant piece from a policy perspective as those facts are informative for policy-makers who are trying to assess the risks associated with such booms. The next step is naturally to find ways to properly identify the policies that are effective in limiting excessive credit expansions–the ones that typically lead to financial crises.

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In 2008, the United States and Western Europe were overwhelmed by a financial systemic crisis, which was followed by a severe economic recession. This sequence of events was not unique: financial crises are recurrent systemic phenomena, often-triggering deep and long-lasting recessions with large reductions in aggregate welfare and employment.

Systemic financial crises are typically not random events triggered by exogenous events, but they tend to occur after periods of rapid credit growth in conjunction with other financial imbalances–notably real estate price bubbles. Conditional on a financial crisis, these ex ante debt booms are associated with higher ex post systemic costs, both within the financial sector (e.g. bank failures) and in the economy at large (e.g. large unemployment, poverty or large fiscal costs).

Their damaging real effects have generated a broad agreement among academics and policy-makers that financial regulation needs to get a macroprudential dimension that aims to lessen the negative externalities from the financial to the macro real sector, as in a credit crunch in a financial crisis caused by the weakening in banks' balance sheets (both bank capital and liquidity crunch).

Therefore, it is important for policy-makers, academics and even citizens to understand the ex ante determinants of financial crises, and the ex post consequences. Dell'Ariccia

et al. analyse key questions on credit booms and busts that are crucial for the understanding of systemic risk and financial crises. In particular, when do credit booms occur? When do they end up in busts, and when do they not? What are the implications for different policies if curbing credit growth and/or mitigating the associated risks is an objective? Importantly, the authors exploit a large dataset, in particular, their sample consist of 170 countries with data starting as far back as the 1960s and extending to 2010. They identify 176 credit boom episodes for their sample period 1970–2010.

Interestingly, they find that credit booms are often associated with financial reform and economic growth. They also tend to be more frequent in fixed exchange rate regimes. Despite that credit booms are the best predictor of financial crises, *only one in three* credit boom episodes are followed by a financial crisis. These booms tend to be larger and last longer. Moreover, they find that macroprudential tools have at times proven effective in containing booms, and more often in limiting the consequences of busts, due to the buffers they helped to build.

I think this paper is crucial for our understanding of financial crises, but also for the limitations of aggregate data, and the role of macroprudential policy. I base my discussion mainly on a book that I co-authored with Xavier Freixas and Luc Laeven on 'Systemic Risk, Crises and Macroprudential Policy'.

As financial crises are rare events, we need large datasets with many episodes of financial crises to understand the ex ante correlates of financial crises. Therefore, the empirical literature analysing large historical (e.g. few countries with more than 100 years) and/or cross-country episodes (e.g. 40 years with 170 countries) of systemic financial crises are crucial. Credit (debt, leverage) booms has the strongest ex ante correlate with the incidence of financial crises in the empirical literature analysing large historical and cross-country episodes of systemic financial crises, and conditional on a crisis occurring, it increases the negative effects on the real economy associated with the crisis.

Credit booms, however, can also result from (and promote) sound economic fundamentals and, therefore, do not contribute negatively to systemic risk. Importantly, Dell'Ariccia et al. have shown that since the 1970s two-thirds of the credit booms did not produce financial crises. Therefore, it is dangerous public policies that mechanically curb credit booms and, in consequence, it is essential on real time to identify the determinants of the bad (as opposed to good) credit booms that cause financial instability. For this end, we need micro data that can separate good from bad credit booms.

For example, Jiménez et al. (2014) identify the effects of monetary policy on credit risk-taking with an exhaustive credit register of loan applications and contracts.[36]

With such matched firm-bank level (including applications) data, one can control for borrower fundamentals (growth opportunities), and analyse the heterogeneity in the credit: for example, do the loans go to the riskier or non-risky firms (bad credit history, high leverage, real estate sector, etc.).

[36] See also Jiménez et al. (2012).

Another important issue that Dell'Ariccia et al. (2016) tackle is macroprudential policy. Macroprudential policy limits systemic risk over the financial cycle, including a preventive, ex ante role for the build-up of systemic risk, where systemic risk is the risk of threats to financial stability that impair the functioning of a large part of the financial system with significant adverse effects on the broader economy. Because systemic crises arise from the build-up of financial imbalances (mainly leverage booms) in the financial sector, the ex ante prevention of excessive risk-taking (not just ex post crisis management and resolution) should be a crucial objective of public policy, in particular of macroprudential and banking policies. Moreover, systemic risk normally arises from ex ante correlated risk choices by individual financial intermediaries and non-financial borrowers (i.e. endogenous systemic risk), not because of risks outside of the financial system (i.e. exogenous risk). Therefore, ex post crisis interventions, such as central bank liquidity injections via expansive monetary policy or government recapitalizations (bailouts) fail to address the root causes of the systemic crisis, and can even cause higher ex ante risk-taking via moral hazard, thereby increasing the likelihood of a systemic financial crisis. While ex post policies are nevertheless important to support the liquidity and capital positions of financial institutions and non-financial borrowers (households and firms), the flow of credit to the real economy, and asset prices in crisis times, macroprudential policy applied in booms should be the crucial line of defence to combat systemic risk.

Excessive credit booms are damaging for systemic risk, and can result in credit crunches in financial crises. Some key instruments to reduce excessive leverage in booms and to reduce the costs in the real economy once the crisis arrives are respectively: (i) eliminating or reducing the debt tax shields in favour of debt over equity (debt interest payments over dividends), or in buying versus renting houses (as it happened in Spain during the crisis), or by increasing bank capital as in Basel III; and (ii) loans without full recourse as in most states in United States, expansive monetary policy via conventional reduction in monetary short-term interest rates and some unconventional policies such as quantitative easing and reducing long-term interest rates (these expansive policies favour debtors over creditors), loan defaults (including household, bank and country bankruptcy procedures, which are slowly progressing), countercyclical capital requirements (even the dynamic provisioning from Bank of Spain), and maybe potential bailouts of borrowers and lenders, though this should be the last line of policy. It is important to stress that these policies are fiscal via changes in taxes or bailouts and more indirectly by increasing the risk of losses for the central bank in some unconventional monetary policies, or by needing less taxpayer funds in case of higher bank capital (and thus higher bank buffers to withstand a crisis or a potential reduction in crises as bank shareholders lose much more in case of excessive risk).

All in all, at both the local and international level, we need better public policy–a combination of banking, macroprudential, monetary and fiscal policies–to reduce the likelihood and negative consequences of financial crises. In the rest of this discussion, I want to concentrate on countercyclical capital requirements with some evidence from

Spain to analyse in detail how macroprudential policy can affect credit supply and in turn the real economy.

As credit cycles are key for systemic risk, time-varying macroprudential policy tools can be used to address these cyclical vulnerabilities in systemic risk.[37] Under the new international regulatory framework for banks—Basel III—regulators agreed to vary minimum capital requirements over the cycle, by instituting countercyclical bank capital buffers (i.e. procyclical capital requirements), which aim to achieve two macroprudential objectives at once. First, boosting equity or provisioning requirements in booms provides additional (countercyclical) buffers in downturns that can help mitigate credit crunches. Second, higher requirements on bank own funds can cool credit-led booms, either due to the higher cost of bank capital or because banks internalize more of the potential social costs of credit defaults (via lower moral hazard by having more 'skin in the game'). Countercyclical buffers could hence lessen the excessive procyclicality of credit, i.e. those credit cycles that find their root causes in banks' agency frictions. Smoothing credit supply cycles will cause positive firm-level real effects if bank–firm relationships are valuable and credit substitution for firms is difficult in bad times.

Jiménez et al. (2015) analyse a series of pioneering policy experiments with dynamic provisioning in Spain: From its introduction in 2000:Q3, and change in 2005:Q1 during good times, to its later performance when a severe (mostly unforeseen) crisis shock struck thus allowing to test the countercyclical nature of the policy, and also the changes in bad times (two reductions in 2008:Q4 and in 2009:Q4, and an ad hoc increase in provisions in 2012:Q1 and Q2). These shocks coupled with unique bank-, firm- and loan-level (and loan application) data allow for identification.

In good times, Jiménez et al. (2015) find that banks that have to provision more cut committed credit more to the same firm after the shock—and not before—than other banks. These findings also hold for the extensive margin of credit and for credit drawn, maturity, collateral and credit drawn over committed (an indirect measure of the cost of credit). Hence, procyclical bank capital regulation in good times contracts credit supply. But are firms really affected in good times? Jiménez et al. (2015) find mostly not. Though total committed credit availability by firms drops immediately following the introduction of dynamic provisioning, three quarters after there is no discernible contraction of credit available to firms, as firms easily substitute credit from less affected banks (from both new banks and banks with an existing relationship). Consistently, the authors find no impact on firm total assets, employment or survival.

In bad times things look very different. Banks with higher pre-crisis dynamic provision funds stemming from policy increase their supply of committed credit to the same firm permanently over the whole period 2009–10 (i.e. capital buffers mitigate the credit crunch). Similar findings hold for credit continuation, drawn and drawn over committed (i.e. implying a lower cost of credit), and again for numerous alterations in specification

[37] Jiménez et al. (2015) for more detail.

and instrumentation (as, for example, instrumenting pre-crisis buffers with initial policy provisioning from 2000). Results, moreover, suggest that the mechanism at work is through saving capital in crisis times when profits and shareholder funds are scarce and costly. In addition, banks with dynamic provision funds below ceiling (and hence that benefited most from the lowering of the floor in 2008:Q4 and in 2009:Q4 as they can immediately release capital funds) increase their credit supply only in the quarters around the policy changes. These banks also tighten maturity and collateral, possibly to compensate for the higher risk taken by easing volume.

Strikingly different in bad times (from good times) is that the changes in bank-firm level credit are binding at the firm-level; credit availability permanently contracts more for those firms that borrowed more from banks that when the crisis hit had lower dynamic provision funds stemming from policy. Results with granting of loan applications show that firms cannot substitute for lost bank financing. Consistent with this, the authors find that firm total employment and survival are negatively affected as well.

All in all, Jiménez et al. (2015) shows that countercyclical bank capital buffers mitigate cycles in credit supply and have a positive effect on firm-level aggregate financing and performance. Hence, the aggregate level of capital and its distribution across banks matters.

In sum, I think Dell'Ariccia et al. provide very interesting evidence based on a large dataset: credit booms are a predictor of financial crises, often associated with financial reform and economic growth, only one in three credit boom episodes are followed by a financial crisis; macroprudential tools have at times proven effective in containing booms, and more often in limiting the consequences of busts, due to the buffers they helped to build. Therefore, this paper is crucial for our understanding of financial crises. Their paper also show the limitations of basing policy on aggregate credit data (Basel III) since only one in three credit boom episodes are followed by a financial crisis. In this discussion, I explain the advantages of micro data to detect dangerous credit booms and the role of macroprudential policy with one particular example.

Panel discussion

The general discussion for this paper is unavailable due to an omission from the recording.

APPENDIX 1. 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: (1) 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%; or (2) the annual growth rate of the credit-to-GDP ratio exceeds 20%.

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% as a boom. The start of the boom is the earliest year in which either (1) 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%; or (2) its annual growth rate exceeds 10%.

A boom ends as soon as either (1) the growth of the credit-to-GDP ratio turns negative; or (2) 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%. 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 policy-making. 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 non-bank 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 non-bank 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.

Table A1. Correlation of booms across definitions

Boom dummy constructed using	(1)	(2)	(3)	(4)
Ad hoc threshold[a]	1			
Backward-looking, rolling, cubic trend[b]	1.00*	1		
Hodrick–Prescott over entire series[c]	0.54*	0.55*	1	
Hodrick–Prescott from t_0 to t[d]				
Absolute	0.59*	0.61*	0.66*	1
Relative	0.77*	0.82*	0.50*	0.85*

*Indicates statistical significance at the 1% level. [a]Boom if credit-to-GDP ratio increases by more than 20%; [b]Barajas et al. (2008) definition. Baseline used in this paper; [c]Mendoza and Terrones (2008) definition; [d]Gourinchas et al. (2001) definition.

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 2, 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% as a boom. The correlation between the boom dummies created by these four methodologies is high (Appendix Table A1).[38] Hence, the list of episodes we identify is not very sensitive to the methodology used. In particular, the major booms (e.g. 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 et al. (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% of absolute booms and 38% 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% 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 (Appendix Table A2).

The full list of the countries in our sample (after the 10% criterion is applied) and the boom episodes identified are provided in Appendix Tables A3 and A4.

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

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[a]	112	38
Backward-looking, rolling, cubic trend[b]	176	32
Hodrick–Prescott over entire series[c]	112	37
Hodrick–Prescott from t_0 to t[d]		
Absolute	138	43
Relative	60	42

[a]Boom if credit-to-GDP ratio increases by more than 20%; [b]Barajas et al. (2008) definition. Baseline used in this paper; [c]Mendoza and Terrones (2008) definition; [d]Gourinchas et al. (2001) definition.

Table A3. Country coverage (based on availability of bank credit to GDP)

Country	Period	Country	Period
Afghanistan, I.R. of	1970–1981	Denmark	1970–2008
	2006–2008	Dominica	1978–2008
Albania	1994–2008	Dominican Republic	1971–2008
Algeria	1970–2008	Ecuador	1970–2008
Angola	1995–2009	Egypt	1970–2008
Antigua and Barbuda	1978–2008	El Salvador	1970–2008
Argentina	1970–2009	Equatorial Guinea	1986–2009
Armenia	1995–2008	Eritrea	1995–2008
Australia	1970–2009	Estonia	1993–2009
Austria	1970–2009	Ethiopia	1982–2008
Azerbaijan, Rep. of	1995–2008	Fiji	1970–2009
Bahrain, Kingdom of	1981–2009	Finland	1970–2009
Bangladesh	1974–2008	France	1970–2009
Belarus	1995–2008	Gabon	1970–2009
Belgium	1970–2009	Gambia, The	1970–2009
Benin	1970–2009	Georgia	1996–2008
Bhutan	1983–2008	Germany	1971–2009
Bolivia	1970–2008	Ghana	1970–2006
Bosnia and Herzegovina	1997–2009	Greece	1970–2009
Botswana	1972–2008	Guatemala	1970–2008
Brazil	1970–2008	Guinea	1989–2005
Brunei Darussalam	1999–2007	Guinea-Bissau	1990–2009
Bulgaria	1998–2008	Guyana	1970–2008
BurkinaFaso	1970–2009	Haiti	1992–2008
Burundi	1970–2008	Honduras	1970–2008
Cambodia	1994–2008	Hungary	1982–2008
Cameroon	1970–2009	Iceland	1970–2006
Canada	1970–2008	India	1970–2009
Cape Verde	1987–2008	Indonesia	1980–2008
Central African Republic	1970–2009	Iran, I.R. of	1970–1977
Chad	1970–2009		1979–2009
Chile	1970–2008	Iraq	1970–1976
Hong Kong SAR	1990–2009		2004–2008
China	1985–2009	Ireland	1970–2009
Colombia	1974–2008	Israel	1970–1976
Comoros	1982–2008		1986–2009

(*Continued*)

Table A3. Continued

Country	Period	Country	Period
Congo, Dem. Rep. of	1994–1995	Italy	1970–2009
	2000–2009	Jamaica	1970–2008
Congo, Republic of	1970–2009	Japan	1970–2008
Costa Rica	1970–2008	Jordan	1970–2009
Croatia	1994–2008	Kazakhstan	1996–2008
Cyprus	1970–2009	Kenya	1970–2008
Czech Republic	1993–2008	Korea, Republic of	1970–2009
Côte d'Ivoire	1970–2009		
Kuwait	1970–1989	Romania	1996–2008
	1991–2008	Russian Federation	1996–2008
Kyrgyz Republic	1997–2007	Rwanda	1970–2005
Lao People's Dem. Rep	1989–2008	Saudi Arabia	1970–2009
Latvia	1993–2008	Senegal	1970–2009
Lesotho	1973–2008	Serbia, Republic of	1998–2008
Libya	1991–2009	Sierra Leone	1970–2009
Lithuania	1993–2008	Singapore	1970–2009
Macedonia, FYR	1995–2008	Slovak Republic	1993–2008
Madagascar	1970–2009	Slovenia	1993–2009
Malawi	1970–2009	Solomon Islands	1978–2008
Malaysia	1970–2008	South Africa	1970–1990
Mali	1970–2009		1992–2008
Malta	1971–2009	Spain	1972–2009
Mauritania	1970–2009	Sri Lanka	1970–2009
Mauritius	1977–2008	Sudan	1970–2008
Mexico	1970–2008	Suriname	1970–2008
Micronesia, Fed. Sts.	1995–2009	Swaziland	1970–2008
Moldova	1994–2008	Sweden	1970–2008
Mongolia	1991–2008	Switzerland	1970–2009
Montenegro	2002–2009	Syrian Arab Republic	1970–2008
Morocco	1970–1985	SãoTomé and Príncipe	2002–2008
	1990–2009	Tajikistan	1998–2007
Mozambique	1988–2008	Tanzania	1989–2008
Myanmar	1970–2004	Thailand	1970–2008
Namibia	1990–2008	Timor–Leste	2002–2008
Nepal	1970–2008	Togo	1970–2009
Netherlands	1970–2009	Tonga	1976–2008
New Zealand	1970–2009	Trinidad and Tobago	1970–2009
Nicaragua	1970–2008	Tunisia	1970–2009
Niger	1970–2009	Turkey	1970–2008
Nigeria	1970–2008	Uganda	1970–2008
Norway	1970–2006	Ukraine	1995–2008
Oman	1972–2008	United Arab Emirates	1974–2009
Pakistan	1970–2007	United Kingdom	1970–2009
Panama	1970–2008	United States	1970–2008
Papua New Guinea	1973–2008	Uruguay	1970–2008
Paraguay	1970–2008	Venezuela, Rep. Bol.	1970–2009
Peru	1970–2009	Vietnam	1992–1993
Philippines	1970–2007		1995–2009
Poland	1986–2008	Zambia	1970–1991
Portugal	1970–2009		1993–2008
Qatar	1971–2008	Zimbabwe	1985–2005

Table A4. Boom episodes by country

Country	Period	Country	Period
Argentina	1977–1979	Fiji	1989–1991
Argentina	1987–1987	Fiji	2000–2001
Argentina	1992–1994	Fiji	2005–2006
Argentina	2005–2007	Finland	1985–1989
Australia	1984–1986	Gambia, The	1976–1978
Bahrain, Kingdom of	1991–1992	Gambia, The	2006–2008
Bangladesh	1994–1996	Greece	1999–2001
Belarus	2003–2008	Greece	2005–2007
Belgium	1988–1989	Guatemala	1994–1995
Belgium	2006–2007	Guatemala	2003–2003
Benin	1985–1986	Guyana	1981–1984
Benin	2003–2008	Guyana	1986–1988
Bolivia	1975–1978	Guyana	1994–1998
Bolivia	1987–1993	Honduras	1996–1999
Bosnia & Herzegovina	2002–2008	Honduras	2006–2007
Botswana	1998–2000	Hungary	2000–2000
Brazil	1986–1988	Hungary	2003–2007
Brazil	1992–1994	Iceland	1982–1983
Brazil	2006–2008	Iceland	1997–1997
Bulgaria	2002–2008	Iceland	1999–2000
Burundi	1998–2002	Iceland	2003–2006
Cameroon	1977–1978	India	1975–1977
Cameroon	1980–1981	India	1999–2002
Central African Rep.	1974–1974	India	2004–2006
Chile	1977–1981	Indonesia	1989–1990
China,P.R.: Mainland	2009–2010	Ireland	2004–2006
Colombia	1980–1981	Israel	1972–1974
Colombia	1989–1990	Jamaica	1981–1983
Colombia	2006–2007	Jamaica	1987–1989
Costa Rica	1992–1993	Jamaica	2002–2004
Costa Rica	1996–2001	Jamaica	2006–2007
Croatia	2001–2006	Japan	1987–1988
Cyprus	1991–1991	Jordan	1973–1976
Cyprus	1996–1999	Jordan	1978–1979
Cyprus	2006–2008	Jordan	2004–2006
Czech Republic	2005–2007	Kenya	2008–2008
Denmark	1986–1988	Korea, Republic of	1978–1980
Dominican Republic	1999–2000	Korea, Republic of	1996–2002
Ecuador	1993–1994	Kuwait	1994–1996
Egypt	1974–1977	Latvia	2002–2006
Egypt	1994–1999	Lesotho	1984–1985
El Salvador	1983–1985	Lesotho	1993–1994
El Salvador	1992–1995	Lesotho	1997–1997
Estonia	2002–2007	Lithuania	2003–2007
Macedonia, FYR	2006–2008	Russian Federation	2003–2007
Madagascar	1977–1980	Saudi Arabia	2004–2005
Malawi	1978–1979	Senegal	1972–1974
Malaysia	1978–1986	Senegal	1977–1979
Malaysia	1995–1997	Senegal	2000–2000
Malta	1989–1991	Senegal	2005–2005
Mauritania	1999–2004	Serbia, Republic of	2004–2005
Mauritius	1997–1998	Serbia, Republic of	2007–2008
Mexico	1989–1994	Singapore	1978–1981
Mexico	2006–2007	Slovak Republic	1996–1997
Micronesia, Fed. Sts.	2004–2006	Slovak Republic	2005–2007
Moldova	2001–2007	Slovenia	1998–1999

(*Continued*)

Table A4. Continued

Country	Period	Country	Period
Morocco	1973–1974	Slovenia	2004–2007
Morocco	1991–1993	Spain	2003–2007
Mozambique	2005–2006	Sri Lanka	1977–1979
Myanmar	2000–2001	Suriname	1996–1998
Nepal	1994–1995	Suriname	2007–2008
Nepal	2006–2008	Swaziland	2002–2006
Netherlands	1998–2000	Sweden	1988–1989
New Zealand	1984–1987	Thailand	1976–1978
Nicaragua	1997–1999	Thailand	1987–1995
Niger	1978–1980	Togo	1976–1977
Nigeria	1980–1982	Tonga	1985–1988
Norway	1984–1987	Trinidad and Tobago	1976–1978
Oman	1983–1984	Trinidad and Tobago	1997–1998
Oman	1997–1997	Tunisia	1981–1982
Pakistan	2003–2004	Tunisia	1989–1989
Panama	1991–1993	Tunisia	2000–2000
Panama	1998–2001	Turkey	1981–1982
Papua New Guinea	1980–1982	Turkey	1995–1997
Papua New Guinea	1997–1998	Turkey	2004–2008
Papua New Guinea	2005–2008	Ukraine	2002–2007
Paraguay	1991–1994	United Arab Emirates	1986–1987
Paraguay	2007–2008	United Arab Emirates	2005–2008
Peru	2006–2007	United Kingdom	1972–1973
Philippines	1978–1979	United Kingdom	1981–1984
Philippines	1992–1997	United Kingdom	1988–1989
Poland	2006–2008	United Kingdom	2006–2008
Portugal	1995–2001	Uruguay	1977–1979
Qatar	1982–1983	Uruguay	2001–2002
Qatar	1985–1987	Venezuela, Rep. Bol.	1975–1976
Qatar	1991–1992	Vietnam	1999–2007
Qatar	2005–2007	Zambia	1981–1982
Romania	2003–2007	Zimbabwe	1991–1993

APPENDIX 2. POLICY RESPONSES TO CREDIT BOOMS

Table A5. 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.

(*Continued*)

Table A5. Continued

Measure	Countries	Impact assessment
Removal of incentives for borrowing in the tax code	Estonia, Lithuania[b], Netherlands, Poland, United Kingdom	Gradual facing out of mortgage interest deductibility was somewhat successful in the United Kingdom, 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[b], Peru[a, b], Romania[a], Russia[a], Serbia, Ukraine, Uruguay[a]	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[a], Portugal[a], Switzerland[b]	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[b], Croatia, Estonia[a], Iceland, India, Ireland, Italy, Malaysia, Norway[a], Poland[a], Serbia, Spain, Turkey, Uruguay[a]	
Liquidity requirements	Argentina[a], Brazil[a], Colombia, Croatia, France[b], Iceland, New Zealand[b], Turkey[a], Uruguay[a]	More than the impact on credit growth, the improvements in liquidity positions were to praise.
Dynamic/Increased provisioning	Bolivia, Bulgaria, Colombia, Croatia, Greece, India, Mongolia[b], 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[a], Austria[a], Bulgaria, Brazil[a], China, Colombia, Croatia, Greece, Hong Kong SAR, Hungary[a, b], Korea[a, b], Malaysia, Romania[a], Serbia, Singapore, Turkey[a]	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.

(*Continued*)

Table A5. Continued

Measure	Countries	Impact assessment
Limits on loan-to-value ratio	Brazil[a, b], Canada[b], Chile, China, Colombia, Croatia, Hong Kong SAR, Hungary[a, b], India, Korea, Latvia, Malaysia, Norway[b], Romania, Singapore, Slovak Republic, Sweden[b], Thailand, Turkey[b]	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, Croatia, France[b], Greece, Hong Kong SAR, Hungary[a, b], Korea, Malaysia, Norway[b], Poland[b], Romania, Thailand	
Exposure/credit concentration limits	Colombia, France, Hong Kong SAR, Malaysia, Mexico, Mongolia[b], New Zealand[b], Nigeria, Peru[b], Poland, Portugal, Romania, Serbia, South Africa, Thailand, Ukraine, Uruguay	
Net open position limits	Argentina, Colombia, Hungary, Indonesia, Israel[a, b], Korea[a, b], Malaysia, Mexico, Nigeria, Peru[b], Romania, Russia, Serbia, South Africa, Thailand, Turkey, 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.
Maturity mismatch regulations	Italy, Mexico, Mongolia[b], New Zealand[b], Singapore, South Africa, Uruguay	

Sources: IMF country reports; Enoch and Ötker-Robe (2007); Borio and Shim (2007); Crowe et al. (2011); Lim et al. (2011); Terrier et al. (2011); Detragiache et al. (2012).

Notes: 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). [a]Denotes the cases in which the measure was applicable to a certain type of lending, most commonly, foreign currency-denominated loans. [b]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 A6. 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	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.

(*Continued*)

Table A6. Continued

	Potential impact	Side effects	Practical issues
Differentiated capital requirements			
Higher risk weights			
Liquidity requirements			
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	(Could) limit rapid expansion and leverage while decreasing probability of default.	Costs associated with potential credit rationing.	Calibration is difficult, circumvention is easy.
Limits on debt-to-income ratio			
Credit concentration limits			
Net open position limits	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.
Maturity mismatch regulations			
Monitoring measures			
Intensified surveillance on vulnerable banks	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.
Stress testing			
Stronger disclosure requirements			

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