SYSTEMIC RISK, MONETARY AND MACROPRUDENTIAL POLICY

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I analyze the relationship between credit cycles and systemic risk, and their interaction with monetary and macroprudential policy. In particular, I answer the following questions: Are credit cycles one of the main determinants of the likelihood and severity of systemic financial crises? Do macroprudential and monetary policy affect credit supply cycles? The evidence summarized in this article shows that credit cycles are crucial for systemic risk – they are the main *ex-ante* correlate of financial crises, and conditioned on crises, they are associated to worse real effects – and, importantly, monetary and macroprudential policy are key determinants of credit supply cycles and excessive risk-taking.

1 Introduction

In 2008 the economies of the United States and Western Europe, including Spain, were overwhelmed by a banking crisis, which was followed by a severe economic recession, with important costs in terms of aggregate output and employment.[1] These phenomena are not unique: Banking crises are recurrent phenomena, triggering deep and long-lasting recessions [see Kindelberger (1978) and Reinhart and Rogoff (2008) for historical evidence]. The main channel by which banks' balance-sheet weaknesses affect the real economy is via a reduction of the supply of credit, a credit crunch, and also through some compositional changes of credit supply as a significant reduction of appetite for risk. Importantly, banking crises are not random events that come from exogenous risks, but come after periods of very strong private credit growth [Schularick and Taylor (2012)]. Therefore, for systemic risk, it is crucial to understand the determinants and implications of credit in good and bad times – the so-called credit cycles.

Monetary policy, moreover, has been crucial in dealing with the costs associated to the financial crisis after September 2008, both in terms of interest rate policy and in terms of central bank liquidity operations as Long-term Refinancing Operations (LTROs) in the euro area or quantitative easing in US, but also some commentators have argued that low monetary policy rates in the euro area and US during the 2000 expansion were crucial to trigger a credit boom and asset price bubble.

There is more agreement among academics and policymakers that financial regulation needs to acquire a macroprudential dimension that ultimately aims to lessen the potentially damaging negative externalities from the financial to the macroeconomic real sector, as for example in a credit crunch. Importantly, as systemic risk is endogenous with a build-up of financial imbalances over time (for example, credit supply booms in correlated risk exposures as in an asset price bubble, for instance in real estate, financed with foreign short-term wholesale finance), an important mission for macroprudential policy is to curb *ex-ante* (pre-crisis) excessive risk-taking by banks, not just deal with *ex-post* crisis management.

Countercyclical macroprudential policy tools could be used to address these cyclical vulnerabilities in systemic risk, by slowing excessive credit growth in good times and especially by boosting it in bad times. 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). As part of the cyclical mandate of macroprudential policy the objective is

that in booms capital requirements will increase while in busts requirements will decrease, thus increasing the buffers of capital that banks have when a crisis hits.

A key explanation of credit supply cycles is based on an agency view, where this view highlights agency problems at the core of the build-up of systemic risk that have to do with the difficulties of aligning the incentives between the principal (for instance, bank bondholders or the taxpayers) and the agent (bank managers or shareholders). This is the channel we highlight in this article, but another important view is the preference channel, in particular behavioral biases as for example neglecting tail risk in good times or overoptimistic behavior by market participants [see Gennaioli, Shleifer and Vishny (2012); Freixas, Laeven and Peydró (forthcoming)]. Depending on which is the correct view of the determinants of excessive risk-taking (preferences *vs.* agency channel) in financial intermediaries, optimal prudential policy will be different. For example, higher capital requirements would be positive by increasing buffers in a crisis under both channels, but under the agency channel they may also reduce *ex-ante* excessive risk-taking by making the financial intermediaries have more own skin in the game.

This article analyzes the relationship between credit cycles and systemic risk, and the interaction with monetary and macroprudential policy, where systemic risk is defined, based on Freixas, Laeven and Peydró (forthcoming), as "the risk of threats to financial stability that impair the functioning of the financial system as a whole with significant adverse effects on the broader economy." In particular, I analyze the following questions: Are credit cycles one of the main determinants of the likelihood and severity of systemic financial crises? Do macroprudential and monetary policy affect credit cycles? Our emphasis is associated to credit supply cycles, *i.e.* the ones not associated to borrowers' stronger economic fundamentals.

In the rest of this article, first, I define credit supply cycles and excessive risk-taking in credit, and its relationship with systemic risk and financial crises. Second, I analyze the impact of monetary policy on credit supply based on evidence from Spain. Third, I analyze macroprudential policy, in particular the impact on credit supply of countercyclical capital requirements stemming from the Spanish experience with dynamic provisioning. Finally, I offer some concluding remarks.

2 Credit booms, systemic risk and financial crises

The cycles in credit growth consist of periods during which the economy is performing well and credit growth is robust (on average 7%) and periods when the economy is in recession or crisis and credit contracts [on average -2% for a sample of 14 major developed countries over the last 140 years, see Schularick and Taylor (2012) and their following papers with Oscar Jordà)].[2] Credit cycles stem from either: 1) Non-financial borrowers' agency frictions and investment opportunities (credit demand) as in, for example, Bernanke and Gertler (1989), Kiyotaki and Moore (1997), Lorenzoni (2008), and Jeanne and Korinek (2010), where better investment opportunities or better firms' and households' collateral and net worth imply higher credit, or 2) banks' agency frictions (credit supply) as in, for example, Rajan (1994), Holmstrom and Tirole (1997), Diamond and Rajan (2006), Allen and Gale (2007), and Adrian and Shin (2011), where changes in bank capital, liquidity and competition allow changes in credit supply. Maddaloni and Peydró (2011) shows the change in lending conditions associated to credit supply and demand factors for Europe and US.

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2 Aggregate granted credit is not as forward looking as change in the supply of committed credit as it is also affected by credit demand, notably drawn down of existing credit lines; instead, change in lending standards from lending surveys from central banks is more forward looking [see Maddaloni and Peydró (2011)].

The main explanation of credit supply cycles in this article is based on an agency view. The agency view highlights agency problems at the core of the build-up of systemic risk that have to do with the difficulties of aligning the incentives between the principal (for instance, bank bondholders or the taxpayers) and the agent (bank managers or shareholders). First, the basic agency problem stems from the fact that most financial intermediaries have limited liability (their losses are limited) and invest money on behalf of others (the final investors). Moreover, they are highly leveraged, notably banks that are funded almost entirely with debt, notably short-term (some banks are funded with 50 units of debt over 1 of equity and many have leverage ratios higher than 30 to 1). These frictions create strong incentives for excessive risk-taking as there is little skin in the game for bank shareholders but high potential upside profits. Second, excessive risk-taking notably increases when there are explicit and implicit guarantees and subsidies from the government (taxpayers) in case of negative *ex-post* aggregate risks (such as a financial crisis). This increases e*x-ante* agency problems of financial intermediaries as financial gains are privatized, but losses are in great part socialized.

For example, the excessive credit boom and lending standards deterioration in the USA and Spain real estate market before the recent crisis has partly been blamed on several factors: i) the financial innovation that fostered in the USA the development of an unregulated shadow banking system to arbitrate (evade) bank capital regulation; ii) in the USA and Spain strong funding liquidity through securitization sold to foreign financial intermediaries due to financial globalization [in Spain more covered bonds than Asset-backed Security (ABS)]; iii) deficient corporate governance and lack of market discipline; iv) very loose monetary policy [in Spain real interest rates were negative as Germany was having low Gross Domestic Product (GDP) growth and the European Central Bank (ECB) had therefore too low monetary rates for countries like Spain and Ireland]; and v) prudential regulation and supervision focused too much on micro, rather on the whole financial system and the real economy – *i.e.,* macroprudential. Moreover, the potential government bailouts imply a lack of market disciplining by bank creditors by not imposing losses on these debt-holders (as in the case of Ireland), which creates *ex-ante* moral hazard and appetite for excessive risk.[3]

The theory suggests that financial intermediaries might take excessive *ex-ante* risks, increasing collectively the systemic risk in the financial system. But what are the specific factors and decisions that will cause excessive risks? The main channel is excessive credit and leverage. In fact, these variables show the strongest *ex-ante* correlate with the incidence of financial crises as shown in the empirical literature analyzing large historical and cross-country episodes of systemic financial crises. Private credit (debt and leverage) acceleration notably increases the likelihood of financial crises, and conditional on a crisis occurring, it increases its systemic nature and the negative effects on the real economy associated with the crisis.

The recent financial crisis has come after a period of significant credit expansion. In order to understand systemic risk, we need to know whether this fact is unique to this crisis or shared among many financial crises. However, financial crises are not frequent events, and hence in order to study the determinants of such crises it is necessary to use long time series for several countries. Schularick and Taylor (2012) analyze the relationship of financial crises with aggregate bank credit growth. They build a 140-year panel data set for fourteen developed countries and construct bank credit and total asset series. Before the Great

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3   See Pagano (2012), Stein (2013) and Freixas *et al.* (forthcoming).

Depression, money and credit aggregates have a stable relationship with GDP, increasing before the crisis and decreasing afterwards. After the 1940s, credit itself decoupled from broad money by increasing leverage and funding via nonmonetary liabilities of banks.

Schularick and Taylor (2012) also analyze the likelihood and severity of financial crises and show that changes in bank loans are a strong predictor of financial crises. Furthermore, broad money aggregates do not have the same predictive power, particularly in the post-1940 period. Jordà, Schularick and Taylor (2011) study the role of credit in the whole business cycle, not only around financial crises. They find that financial-crisis recessions are more costly than normal recessions in terms of lost output, and for both types of recessions, they show that the financial imbalances built up in the period preceding the crisis (bank credit) are important drivers of the strong negative real effects to the broad economy during the crisis. Specifically, not only does *ex-ante* credit growth affect the likelihood of a financial crisis, but conditional on a crisis, the real effects are worse when the crisis is preceded by a credit boom. Therefore, this historical analysis shows that *ex-ante* financial imbalances are a first-order determinant of systemic risk.

Their findings suggest that the prior evolution of credit shapes the business cycle. This has important implications for macroeconomic models: if credit were to just follow economic fundamentals and had little impact on the business cycle, then models omitting the frictions in the financial sector might be sufficient. Nevertheless, these findings suggest that more sophisticated macro models featuring financial intermediation are needed.

Using the same dataset, Jordà *et al.* (2011) analyze whether *ex-ante* external imbalances increase the risk of financial crises. In other words, are external imbalances associated with higher costs in the recession, or are credit booms the only important variable? Their overall finding is that *ex-ante* credit growth emerges as the single best predictor of financial instability; however, the correlation between current account imbalances and credit booms has increased significantly in the recent decades, which indicates that financial globalization plays a role as well. In a globalized economy, with free capital mobility, credit cycles and foreign capital flows have the potential to reinforce each other more strongly than otherwise [on this argument, see also Shin (2012)]. Clearly, a strong and sustained credit boom cannot typically be financed with an increase of domestic deposits and wealth (especially if not driven by very strong fundamentals); therefore, foreign liquidity, or liquidity stemming from expansive monetary policy or financial innovation *(e.g.,* securitization), need to be present and interact with credit cycles.[4] Finally, Jordà *et al.* (2013) show that the main determinant is *ex-ante* private (bank) credit rather than public debt.

The historical evidence clearly suggests that high rates of credit growth coupled with widening imbalances pose financial stability risks that policy makers and academics should not ignore. Moreover, in the recent crisis, the credit booms and large current account imbalances in many countries, low levels of short-term (monetary) and long-term rates, and increasing recourse to securitization, all seem to confirm that credit growth and capital inflows and other forms of liquidity nowadays interact in a stronger way. Maddaloni and Peydró (2011) analyze these issues for the recent crisis. Using the survey of lending conditions and standards for the euro area countries and the USA that the national central banks and regional Feds request from banks, they analyze the determinants of lending conditions and standards for the financial crisis that started in 2007. They find that countries with worse economic performance during the crisis are those with *ex-ante* softer lending

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4   Of course, some credit booms can be financed by domestic savings as we are seeing recently with China.

conditions. They also find that lower monetary policy rates imply softer lending conditions and standards. However, after controlling for key factors (such as country fixed effects and business cycle conditions), current account deficits or lower long-term interest rates do not correlate with softer lending conditions. Finally, Maddaloni and Peydró (2011) find that lending standards are pro-cyclical (in the upside of the business cycle, lending conditions are softer and banks take on higher risk), a result consistent with Jiménez and Saurina (2006) for Spain.

Credit booms are therefore a crucial *ex-ante* correlate of financial crises. Yet, all of these empirical analyses condition on the occurrence of a crisis and ask what its determinants are. But, do all credit booms end up in a crisis? The International Monetary Found [IMF (2012)] analyzes credit booms for 170 countries over the last 40 years of data. They show three important results: credit booms have become more frequent after the 1980s (a period of significant financial deregulation); most booms happen in relatively underdeveloped financial systems; and only one in three credit booms end up in a financial crisis.

Credit booms, however, may also result from (and promote) sound economic fundamentals (demand-driven credit) and, therefore, could be benign for systemic risk.[5] For example, since 1970s across a broad range of countries, research has shown that two thirds of credit booms did not end up in a financial crisis [IMF (2012)]. Therefore, a key question that we analyze is what are the determinants of the bad credit booms, in particular the ones associated with credit supply *(i.e.,* based on pervasive bank incentives). Credit supply booms that are negative for systemic risk generally stem from correlated risk-exposures by the financial intermediaries that end up developing asset-price bubbles in real estate or in other asset classes. This herding by financial intermediaries may also make small and medium banks become systemic since the government may *ex-post* bailout them, as otherwise there would be *too many to fail.* Deficient corporate governance where bank managers maximize only bank shareholder value (a small part of the bank total assets) with executive compensation based on relative performance with stock options and lack of claw-back options or based on some political objectives as in the Spanish cajas may also encourage this type of excessive risk-taking.

We have seen that credit booms appear to precede financial crises, but only one third end up in a crisis, thus an important part of credit booms are driven by strong economic fundamentals and do not pose a risk for systemic risk. What are the determinants of credit supply booms and other financial imbalances? How can we measure bad credit booms? In the rest of the article, I summarize evidence based on loan level data, including loan applications, where we can isolate credit supply changes associated to low bank capital ratios.

3 Monetary policy and credit supply

To finance a credit supply boom, there is a need for bank liquidity. Liquidity can come from expansive monetary policy, from financial innovation (for example, securitization) or from foreigners (for example, through financial globalization).[6] In this section we analyze the different sources and the implications for financial imbalances stemming from credit supply cycles.

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5 This does not mean that all demand-driven credit booms result from fundamentals. For example, they can be driven by collateral values. Although there is an extensive literature focusing on frictions on credit demand, it is not the focus of this article.

6 For financial globalization, see Kalemli-Ozcan, Papaioannou and Peydró (2010 and 2013). For securitization, see Jiménez, Mian, Peydró and Saurina (2013) and Maddaloni and Peydró (2011 and 2013). In Jiménez, Mian *et al.* (2013), we focus on the effects of securitization on lending from Spanish banks, where securitization was done using real-estate loans. We find very interesting results that shed light on how credit booms are characterized. Securitization did not affect firms with already strong access to the banking sector. However, it was the extensive margin *(i.e.,* new borrowers) the ones that were more affected for credit volume supplied. Banks engaged in real estate activities were able, through securitization, to expand their credit to new borrowers, which are usually riskier and, in fact, defaulted more. In Maddaloni and Peydró (2011 and 2013) we find that securitization also implied a softening of lending conditions and standards in Europe and the USA.

A key question in macroeconomics and finance is whether monetary policy, and in general economic conditions, affects bank loan supply [Bernanke and Gertler (1989), Bernanke and Gertler (1995)] and whether credit availability depend on bank balance-sheet strength [Bernanke (2007)]. That is, do agency costs of borrowing between banks and their financiers – proxied by bank capital and liquidity to total assets ratios as in Holmstrom and Tirole (1997) and Diamond and Rajan (2011), for example – make lending significantly more problematic during periods of higher monetary policy rates or lower economic activity? Put differently, is a bank lending channel operational, and, if so, how potent is it?

To convincingly answer these questions two major identification challenges need to be addressed. First, the supply of credit needs to be disentangled from its demand. Tighter monetary conditions and lower economic growth may reduce both loan supply and demand. Supply may contract because – as already indicated – agency costs of banks may increase, but demand may contemporaneously fall because firm net worth and expectations for investment are reduced, and the cost of financing is higher. In addition, firms affected more by monetary and economic conditions may borrow more from affected banks [Gertler and Gilchrist (1994)]. All this implies that any analysis based only on macro data [Bernanke and Blinder (1992)] or bank-level data [Kashyap and Stein (2000)] may suffer from an omitted-variables problem. Second, if country business cycle conditions completely determine short-term interest rate changes, which may be the case in many countries [e.g., through a Taylor (1993) – rule], separating the effects of monetary conditions from those of economic activity is problematic.

Our main contribution to the literature in Jiménez *et al.* (2012) consists in taking crucial steps in addressing both identification challenges. In particular, we analyze the effects of monetary conditions and economic activity on the granting of loans with individual loan application records depending on the strength of bank balance sheets measured by bank capital and liquidity ratios, controlling for time-varying observed and unobserved firm heterogeneity with firm-month fixed effects (*i.e.,* there is a dummy for every firm-year: month combination). The data are from Spain, a country where most firms are bank dependent and where monetary policy has been fairly exogenous.

Unique features of the Credit Register of Spain (CIR), which is collected by the Banco de España acting in its capacity as bank supervisor, help us to attain identification. Since 2012 the CIR recorded all monthly information requests lodged by banks on borrowers. Because banks monthly receive information on all outstanding loans and defaults of their current borrowers from CIR, they lodge information requests only following loan applications from firms that are currently not borrowing from them. Because the CIR database also contains detailed monthly information on all, new and outstanding, loans (over 6,000 euros) to non-financial firms granted by all credit institutions operating in Spain since 1984, we can match the set of corresponding loan applications with the loan that is actually granted by a bank. The loans granted to noncurrent borrowers surely do not involve simply the renewal or evergreening of outstanding loans. Moreover, Banco de España has complete monthly bank balance-sheet information also collected in its role as bank supervisor and has access to key firm characteristics, including identity. We analyze 2,335,321 loan applications in total and in Jiménez *et al.* (2013 and 2014) we also analyze all credit granted, in addition to loan applications.

The unique features of the CIR allow us to address the two major identification challenges. First, to separate bank loan supply from demand we study loan applications and exploit theoretically motivated interactions between economic and monetary conditions on the

one hand and bank balance-sheet strength variables on the other [Bernanke, Gertler and Gilchrist (1996), Kashyap and Stein (2000)]. The definition of the bank capital and liquidity to total assets ratios we employ closely follows the theoretical literature that attributes a prominent role to net worth in reducing the agency costs of borrowing.

To achieve identification we further focus on the set of loan applications made in the same month by the same borrower or for the same loan to different banks of varying balance-sheet strengths (by including in the specifications firm-month or alternatively loan fixed effects). Within this set of loan applications, for which the (observed and unobserved) quality of potential borrowers is constant as in the credit crunch definition by Bernanke and Lown (1991), we study how monetary and economic conditions affect the granting of loans depending on bank capital and liquidity. Moreover, we analyze whether firms that get rejected in their initial loan application can undo the resultant reduction in credit availability by successfully applying to other banks.

Second, to distinguish between the impact of monetary and economic conditions, we rely on the observation that monetary policy in Spain has been fairly exogenous during the sample period. Spain accounts for around 10 percent of the euro area output and as a peripheral country its business cycle did not converge with those of the core countries of the euro area.

Our study yields the following robust results: higher short-term interest rates or lower GDP growth reduce the probability that a loan application is granted. The negative effect of higher short-term interest rate on loan granting is statistically stronger for banks with low capital or liquidity, whereas the negative effect of lower GDP growth is statistically stronger for banks with low capital. The estimated effects are also economically relevant. A 100-basis point increase (decrease) in the interest rate (GDP growth) reduces loan granting by weak banks by 11 (5) percent more than by strong banks *(i.e.,* a weak bank is in the tenth percentile in both bank capital and liquidity; a strong bank is in the ninetieth percentile).

All findings are robust to multiple controls, in particular to the inclusion of firm- month or loan fixed effects, implying that within the set of applications made in the same month or for the same loan by the same firm to different banks, banks with weaker balance sheets grant fewer loan applications when short-term interest rate are higher or when GDP growth is lower. This was the first evidence that clearly identifies that, under tighter monetary or economic conditions, low bank capital or liquidity begets a credit crunch. Finally, we find that- firms that get rejected in their initial loan application cannot undo the resultant reduction in credit availability by applying to other banks, especially in periods of tighter monetary and economic conditions.

3.1 MONETARY POLICY AND RISK-TAKING

But not only too low short term rates can expand credit supply, but also can increase the risk-taking incentives of banks. This is what Adrian and Shin call "the risk-taking channel of monetary policy" in the last Handbook of Monetary Economics [Adrian and Shin (2011)].[7] In Jiménez *et al.* (2014) we study this channel. Since the severe financial crisis of 2007-2009, the question on whether low monetary policy rates cause excessive risk-taking by financial intermediaries has been at the center of an intense academic and policy debate. From the start of the crisis in the summer of 2007, market commentators were swift to argue that during the long period of very low interest rates, stretching from 2002 to 2005, banks had softened their lending standards and taken on excessive risk, whereas others argued that low long-term rates and other factors were the culprit. But, at the same time,

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7   See also Borio and Zhu (2012).

market participants continuously clamored for central banks to reduce the monetary policy rate to alleviate their financial predicament.

Recent theoretical work suggests that expansive monetary policy through the increase in funding provided by households and other agents to banks may cause an increase in risk-shifting in lending, as banks face strong moral hazard problems – especially banks with lower capital amounts at stake, who do not fully internalize loan defaults. A low short-term interest rate makes riskless assets less attractive and may lead to a search for yield by financial intermediaries with short-term time horizons. Acute agency problems combined with a strong reliance on short-term funding may thus lead the short-term (monetary) interest rate – more than the long-term interest rate – to spur bank risk-taking.

Monetary policy rate changes may affect the credit quality of the pool of borrowers through the interest rate channel and the firm balance-sheet channel of monetary policy by changing firm investment opportunities, net worth, and collateral [Bernanke and Gertler (1995)]. Moreover, monetary policy, by affecting bank liquidity, may affect the volume of credit supplied through the bank balance-sheet/lending channel of monetary policy [Kashyap and Stein (2000)]. Therefore, the decisive identification challenge we address is to disentangle the impact of changes in the monetary policy rate on the composition of the supply of credit from changes in the volume of the supply and changes in the quality and volume of demand, while accounting for the impact of other aggregate variables, including long-term interest rates. Importantly, while the bank balance-sheet channel yields testable predictions at the bank level, and the firm balance sheet and interest rate channels at the firm level, the bank risk-taking channel involves compositional changes in the supply of credit at the bank-firm level.

The very detailed data on loan applications and outcomes in Spain has allowed us to identify the effect of monetary policy on banks' risk-taking behavior. We separate the changes in the composition of the supply of credit from the concurrent changes in the volume of supply and quality and volume of demand. We employ a two-stage model that analyzes the granting of loan applications in the first stage and loan outcomes for the applications granted in the second stage, and that controls for both observed and unobserved, time-varying, firm and bank heterogeneity through time "firm and time" bank fixed effects.

We find robust evidence that a lower overnight rate induces lowly capitalized banks to grant more loan applications to ex ante risky firms (than highly capitalized banks), where firm risk is measured with the presence of a bad credit history with nonperforming loans. When granting applications to these firms (when the overnight rate is lower), lowly capitalized banks further commit more credit and require less collateral, yet their granted loan applications overall face a higher future likelihood of default.

All findings are statistically significant and economically relevant. A decrease of 1 percentage point in the overnight rate, for example, increases the probability that a loan will be granted by a lowly versus a highly capitalized bank (with a difference of 1 standard deviation between them) to a firm with a bad credit history by 8 percent and the resultant committed amount of credit increases by 18 percent, while the future likelihood of loan default of these loans increases by 5 percent and the required collateral decreases by 7 percent. A lower long-term interest rate and other key aggregate bank and macro variables, such as more securitization or higher current account deficits, have no such effects. Importantly, when the overnight rate is lower, virtually all banks grant more credit to firms with higher risk (by around 19 percent for the average bank).

In sum, our estimates suggest that a lower monetary policy rate spurs bank risk-taking and hence that monetary policy affects the composition of the supply of credit beyond the well documented effects of both the bank and firm balance-sheet channels. Consistent with "excessive" risk-taking are our findings that especially banks with less capital "in the game", that is, those afflicted more by agency problems, grant more loan applications and resultant credit to ex ante risky firms, that these banks require less collateral requirements from these firms, and that these banks face more default on their granted loans in the future – all bank actions that accord with risk-shifting.[8]

4 Macroprudential policy and credit supply

The 2008-09 global economic and financial crises have changed the consensus on how to conduct prudential regulation. Before it was "micro-oriented", focused on ensuring the solvency of individual financial institutions and paying little attention to the financial system as a whole. The consensus was that by ensuring adequate capital ratios at the individual level, the whole system would be solvent. However, after a negative shock, banks may try to increase their capital buffers by decreasing their lending, which can create a credit crunch and fire sales that can in fact worsen the initial shock. In other words, by trying to increase their *individual* solvency, banks may be imposing negative externalities on the rest of the system, thus decreasing the *overall financial stability.* Micro-prudential policy, hence, is not well equipped to deal with systemic risk. Financial regulation is now becoming more macro-focused, focusing on the risks of the financial system as a whole, both the build-up of financial imbalances, and the externalities within the financial sector and from the financial to the real sector. In other words, going forward prudential regulation should also focus on systemic risk (see Freixas *et al.,* forthcoming).

Examples of this type of macroprudential policy approach are the so-called countercyclical capital buffers. This new policy requires banks to hold additional capital when aggregate credit is expanding fast. The intention is twofold: by requiring this additional capital, banks will be more capitalized when a recession comes, thus alleviating the credit crunch problem. On top of that, the additional capital may cool down the credit expansion, thus lowering both the probability of a crisis and the cost of it if it occurs. Dynamic provisioning, a regulation introduced in 2000 in Spain, is also an example of a macroprudential policy on countercyclical capital requirements.

In Jiménez, Ongena *et al.* (2013) we analyze the impact of countercyclical capital buffers held by banks on the supply of credit to firms and their subsequent performance, exploiting the Spanish dynamic provisioning. Spain introduced dynamic provisioning unrelated to specific bank loan losses in 2000 and modified its formula parameters in 2005 and 2008. In each case, individual banks were impacted differently. The resultant bank-specific shocks to capital buffers, coupled with comprehensive bank-, firm-, loan-, and loan application-level data, allow us to identify its impact on the supply of credit and on real activity.

Our estimates show that countercyclical dynamic provisioning smoothes cycles in the supply of credit and in bad times upholds firm financing and performance. The estimates are also economically relevant. Firms borrowing from banks with a 1 percentage point higher dynamic provision funds (over loans) prior to the crisis get a 6 percentage points higher credit growth, a 2.5 percentage points higher asset growth, a 2.7 percentage points higher employment growth, and a 1 percentage point higher likelihood of survival.

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8 On-going empirical work documents the robust existence and potency of a bank risk-taking channel of monetary policy across many countries and time periods, for example, for the United States, Austria, Portugal, Colombia, Bolivia, Czech Republic and Sweden.

5 Conclusions

Historical evidence shows that either looking at financial crises in the past or looking at the recent global crisis, high *ex-ante* credit booms is the main *ex-ante* correlate in determining the likelihood of systemic financial crises, and conditioning on the crisis, high *ex-ante* credit booms increase the severity of the financial crisis, with stronger negative real effects. Important channels during the crises are credit crunches and during the *ex-ante* pre-crisis are financial imbalances caused by excessive credit growth.

As empirical evidence by several papers co-authored with Gabriel Jiménez, Steven Ongena and Jesús Saurina show, monetary and macroprudential policies affect credit supply cycles and bank risk-taking. Moreover, the effects differ in good and bad times, with very strong effects in crisis times for an increase of credit supply with expansive monetary policy and countercyclical capital buffers. Both policymakers and academics should pay more attention to credit cycles, notably supply driven, and their relation with monetary and macroprudential policies.

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