# Macroprudential Policy,

# Countercyclical Bank Capital Buffers and Credit Supply:

# Evidence from the Spanish Dynamic Provisioning Experiments


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Abstract

We identify how countercyclical bank capital buffers determine credit supply. Spain offers an excellent setting for identification. Policy experiments with dynamic provisioning provide exogenous bank-specific shocks to countercyclical buffers. A comprehensive credit register and employing firm-time effects to account for firm heterogeneity permit identification of credit supply. Our estimates suggest that countercyclical buffers mitigate bank pro-cyclicality. Buffers contract credit availability (volume and cost) during good times, but expanded it during the recent crisis. While bank-level effects are always economically strong, firms are especially affected during crisis times when switching banks is difficult. Our findings therefore hold important implications for Basel III, bank bailouts, monetary policy and, in general, for macroprudential policy.

"The new [capital] standards will markedly reduce banks' incentive to take excessive risks. […] lower the likelihood and severity of future crises, and enable banks to withstand - without extraordinary government support - stresses of a magnitude associated with the recent financial crisis."

G-20 Seoul Official statement, November 2010

# 1. INTRODUCTION

What are the effects of countercyclical bank capital buffers on credit supply? This question is at the heart of the new macroprudential regulation, notably Basel III. As the Seoul G-20 official statement argues higher bank capital standards in good times can be beneficial during both good and bad times by reducing excessive bank pro-cyclicality. During good times, a key issue is how to avoid an "excessive" supply of bank credit sowing the seeds for the next crisis. A solution may be to require banks to hold more bank capital forcing them to internalize better the cost of their lending decisions.[1] During crisis times, on the other hand, a central issue is to minimize the negative externalities stemming from bank distress, in particular a potential contraction in credit supply by lowly capitalized banks. In this case, the higher capital buffers built up during the good times can be mobilized during the not-so-good times to maintain the availability of credit without any government help.

These two complementary rationales of countercyclical bank capital buffers highlighted by policymakers are also present in theoretical models, such as in

[1] Given government support (expected bailouts, deposit insurance and limited liability), the costs of excessive credit supply born by banks are lower than the social costs, thereby leading to bank over-lending. A solution in this case is higher bank capital thereby making banks to internalize more the potential costs of lending. See Freixas and Rochet (200 ) and Degryse et al. (2010).

models with moral hazard (e.g. Holmstrom and Tirole, 1 ), or without moral hazard but with investor sentiment (e.g. Shleifer and Visnhy, 2011).[2]

However, despite this central role assigned to countercyclical bank capital buffers in both policy and theoretical thinking, identifying their effects on the availability of credit remains an unmet empirical challenge. Both shocks to countercyclical buffers and comprehensive loan-level data are needed to convincingly identify their effects on the supply of credit.

Spain offers an almost ideal setting to meet this steep identification challenge. First, Spain witnessed policy experiments with dynamic provisioning, which exogenously changed the banks' retained profits in good times to be used during crisis times. Second, Spain has a comprehensive credit register, matched with bank and firm characteristics, that ensures that credit availability can be identified.

In July 2000, and following a period of sizeable credit growth, the *Banco de España* (which is Spain's central bank and its banking supervisor) decided to put in place dynamic – also called "statistical" – provisions to cope with an increase in credit risk on the Spanish banks' balance sheets. In 1 Spain actually had the lowest ratio of loan loss provisions to total loans among all OECD countries.[3] These developments, coupled with persuasive theoretical arguments on pro-cyclical bank lending and the well-known difficulty in immediately recognizing

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[2] In the next version of the paper, we will cite other relevant theoretical and empirical papers.

[3] For a detailed and exhaustive explanation of the dynamic provisions in Spain, see Saurina (2010a). A shorter review is provided by Saurina (2010b).

problem loans following a credit expansion, led the Spanish supervisor to introduce dynamic provisioning.[4]

These new countercyclical provisions, which were added to existing specific and general provisions, were based on a comparison between a bank's current specific provisions and the average so-called "latent loss" on its loan portfolio. The dynamic provisions are forward looking, i.e., they apply before any sign of incurred losses on an individual loan, and they are countercyclical. During periods of expansion, when incurred losses and specific provisions on individual loans are very low, a dynamic provision is charged on the profit and loss account, building up a fund of retained profits, which can then be used by banks when specific provisions grow above the average latent risk (i.e., during bad times). Because loan portfolios are not homogeneous in credit risk (e.g., credit cards, mortgages and small and medium-size enterprise loans have very different levels of losses), the latent risk differs depending on the type of loan.

To calculate the latent loss the *Banco de España* gave all banks a formula with parameters fixed for each of six different risk classes of loans. The parameters were calibrated using the *preceding* 14 years of credit data (roughly a full business cycle). To avoid an excessive increase in loan loss provisions, a cap was placed on the size of the dynamic fund. Though the formula is the same for all banks, banks have different loan portfolios and, therefore, this policy experiment affected the banks differentially in July 2000 (when the policy was introduced). In 2004, the *Banco de España* revised the formula in response to the adoption of

[4] For pro-cyclical lending standards, see e.g. Dell'Ariccia and Marquez, 2006; Rajan, 1994; Matsuyama, 200 ; Ruckes, 2004. For empirical evidence using Spanish data, see Jimenez and Saurina, 200 ; for evidence from Euro area and U.S., see Maddaloni and Peydro, 2011.

the International Financial Reporting Standards by the European Union in January 2005 providing another exogenous policy shock in good times that affected banks differentially.[5] Finally, in the summer of 200 when the international financial crisis started, banks entered into the crisis with different provision buffers stemming from the dynamic provisions applied up to that moment.

Using a difference-in-difference approach, we compare bank lending before and after the three different shocks (i.e., the introduction and change of the new regulation and the start of the financial crisis). We can differentiate across banks with varying susceptibility to the shocks and employ a full set of time dummies for each firm to control for time-varying heterogeneity in firm loan demand and risk.

We measure each bank's susceptibility to a shock by how much each bank had to dynamically provision relative to its total assets. In July 2000 the *Banco de España*'s new formula on the new dynamic provisions was applied to the existing loan portfolio for each bank yielding a bank-specific amount of new funds to be provisioned. Given that the Spanish economy grew very strongly between 1 and the end of 200 , the first shock we analyze here is situated during good times. For the crisis shock, we assess how much each bank had built up as dynamic provisions just prior to the onset of the crisis.

[5] In this version of the paper we analyze only the introduction of dynamic provisions in July 2000 and the crisis shock of 200 -200 . In the next version we will also add the results on the change of the formula in terms of weights and caps in 2004, which also exogenously changed bank buffers in 2004-2005. Preliminary results suggest very similar findings with this policy shock.

We use the uniquely comprehensive credit register from Spain that, matched with bank and firm relevant information, contains exhaustive loan (bank-firm) level data on *all* outstanding business loan contracts at a quarterly frequency. We calculate the total exposures by each bank to all firms in each quarter from 1 :III to 200 :IV. The sample period includes one year before the initial shock (to run placebo tests) and we have two years of data on the latest global financial crisis. For credit availability, both on the intensive and extensive margin of lending, we analyze change in credit volume (commitment and drawn), maturity, collateral and the cost of lending (proxied by the percentage of drawing down to total committed loans).

Using the loan-level data, we find robust evidence showing that banks with higher provisions due to the new regulation that came into force in the third quarter of 2000 reduce credit availability for firms (as compared to less affected banks), both in terms of credit volume, cost, maturity and collateral. The results are robust to controlling consecutively for key bank, firm, and loan characteristics (notably also firm-time fixed effects) and hold for subgroups of firms such as non-real estate firms, real estate firms, or SMEs. Moreover, when we measure the time-period (i.e., quarter) elasticities of the new regulation on the availability of credit over the period 1 :III-2003:IV, we find that there was no statistical effect until the end of the second quarter of 2000 (when the law came into force), but a strong economic effect in third quarter of 2000 (when the

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We have access to loan application information at the bank-firm level at a monthly frequency since 2002:02, so at this stage we have not used them in the paper given that the initial shock goes back earlier (i.e., July 2000). However, very preliminary results suggest similar effects as the shown in this version of the paper.

In the next version we will add the extensive margin of new lending.

new law was binding). The elasticities remain high in absolute value afterwards. The estimated coefficients suggest that an increase of one standard deviation in buffers, i.e., in provisions (of retained profits) to total assets, reduces the committed volume of credit by banks by almost 3.  percent (  $1- e^{-0.41 * 0.0}$ ; estimated coefficients equal around -0.41; mean of buffers  0.4  percent, standard deviation  0.0  percent). Finally, when we use firm-level data to analyze credit substitution by firms within the banking system, we find that firms with higher ex-ante borrowing from banks with higher buffers obtain less credit. However, the estimated elasticities are reduced in absolute value as compared to those ones employing firm-bank level data. For a similar increase in buffers (of 0.0  percentage points) committed volume of credit at the firm level contracts by at most 1.5 percent (  $1- e^{-0.1\ 2 * 0.0}$ ), suggesting a strong ability for firms (during good times) to switch from the more affected banks towards the less affected ones.

Next, we analyze the crisis period. Controlling for other bank characteristics, we find robust evidence that banks that had provisioned more (due to the dynamic provisioning requirements) prior to the start of the crisis (200 :IV) expand the availability of credit (both in terms of credit volume and cost) to firms during the crisis. The results are robust to controlling successively for key firm and loan characteristics (again notably firm*time fixed effects) and hold for subgroups of firms such as non-real estate firms, real estate firms, and SMEs. Moreover, when we measure the quarter elasticities of ex-ante provision buffers on credit availability over 200 :II-200 :IV, we find that there were no statistically significant or economically relevant effects before the crisis. The estimated coefficients during the crisis however suggest that an increase of 0.2

percentage points in ex-ante provision buffers (1 standard deviation of buffers in 200 ) increases credit availability during the crisis by more than percent ( $e^{0.350 * 0.2} - 1$). Finally, analyzing the firm-level data we find that firms with higher ex-ante borrowing from banks with lower ex-ante provision buffers had lower credit availability during the crisis. Opposite to the shock during good times, the elasticities are almost *not* reduced as compared to the firm-bank level data, thus suggesting a limited ability for firms during the crisis to substitute credit from the banks with lower ex-ante buffers towards banks with higher buffers. An increase of 0.2 percentage points in ex-ante provision buffers for example still increases credit availability for individual firms during the crisis by almost than 5 percent ( $e^{0.23 * 0.2} - 1$).

All in all, the results suggest that countercyclical buffers mitigate bank pro-cyclicality. Bank buffers reduce credit availability in good times, but increase it during crisis times. While bank-level effects are strong both during good and bad times, firms are especially affected during crisis times when switching banks (from low ex-ante to high buffers) seems very difficult. This suggests that not only the buffers of the banking system as a whole may matter but also those of each individual bank.

The paper proceeds as follows. Section 2 discusses the dynamic provisioning in detail. Section 3 introduces the data. Section 4 presents and discusses the results. Section 5 concludes by highlighting the relevant policy implications.

## 2. DYNAMIC PROVISIONING

In this subsection we explain how the loan loss provisioning system currently works. General loan loss provisions are based on four components. The first is called component alpha ($\alpha$), and it is obtained as the product of a certain parameter $\alpha$ times the change in the amount of the loans that is granted. This component reflects the inherent losses of the transactions granted during the period.

The second component beta ($\beta$) is the product of the parameter $\beta$ times the total amount of outstanding loans in the period. This second component is compared with a third component, the specific net provisions made in the period. These last two components take into account the effect of the business cycle on inherent losses and, therefore, form the basis of the macroprudential dimension of the provision. Component $\beta$ reflects the average specific provision over a business cycle. Its comparison with the current specific provision is indicative of the strength/weakness of the lending cycle. During expansion periods non-

recessions, non-performing loans and specific provisions surge; hence, the difference between the second and third components becomes negative. If credit declines, the first component is also negative. The final negative amount is drawn down from the general fund, provided it has a positive balance, and credited to the profit and loss account.

The three components discussed above are used to calculate the theoretical general provision. This means that the initial provision figure calculated on the above terms is not necessarily the final provision to be made, since the limit to the general provision (fourth component) must be taken into consideration. This implies that there is a cap for the fund of general loan loss provisions fixed at 125 of the product of parameter $\alpha$ and the total volume of credit exposures. Therefore, the fund of general provisions should be below 125 of the inherent loss of the loan portfolio. The objective of this cap is to avoid an excess of provisioning, which might occur in a long expansionary phase as specific provisions remain below the beta component, whereas the alpha component contributes positively to the accumulation of provisions in the fund. The cap is intended to avoid a fund that keeps growing indefinitely, producing unnecessarily high coverage ratios of non-performing loans through provisions.

Analytically, one period's total loan loss provisions are the sum of the specific provisions (dot.espe) plus the general one (dot.gen). The formula describing how general provisions (the flow) are computed is as follows:

$$dot.gen_t = \alpha \Delta C_t + \left( \beta - \frac{dot.espe_t}{C_t} \right) C_t$$

where $C_t$ is the stock of loans at the end of period $t$ and $\Delta C_t$ its variation from the end of period *t-1* to the end of period $t$ (positive in a lending expansion, negative in a credit declines). $\alpha$ and $\beta$ are the previously defined parameters, and they are set by the *Banco de España*.

Intuitively, parameter $\alpha$ is the estimated average of credit losses or, in other words, the collective assessment for impairment in a cyclically neutral year for each homogeneous group of risk. Parameter $\beta$ is the historical average (i.e., through a lending cycle) of the specific provisions for each homogeneous loan portfolio. Parameters $\alpha$ and $\beta$ are the same for all banks, although the overall impact will differ depending on the structure of each bank's loan portfolio. During periods of strong credit growth and low levels of specific provisions, $\beta$ is larger than the specific provisions, so that general provisions recognize the increase in incurred losses not yet individually identified on specific loans. During recessions these losses quickly translate into specific losses, and so $\beta$ is below the specific provisions. The difference can be drawn from the general fund and credited to the profit and loss account.

The above formula is in fact a simplification. There are six risk buckets, or homogeneous groups of risk, to take into account the different nature of the distinct segments of the credit market, each of them with a different $\alpha$ and $\beta$ parameter. The values for $\alpha$ are (moving from lower to higher risk levels): 0 ,

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These groups (in ascending order of risk) are the following: i) Negligible risk: includes cash and public-sector exposures (both loans and securities) as well as interbank exposures; ii) Low risk: made up of mortgages with a loan-to-value (LTV) ratio below 0 and exposures to corporations with an A or higher rating; iii) Medium-low risk: composed of mortgages with an LTV ratio above 0 and other collateralized loans not previously mentioned; iv) Medium risk: made up of other loans, including unrated or below-A rated corporate exposures and exposures

0. , 1.5 , 1. , 2 , and 2.5 ; and those for $\beta$: 0 , 0.11 , 0.44 , 0. 5 , 1.1 , and 1. 4 . The final formula to be applied by each bank is therefore:

$$dot.gen_t = \sum_{i=1}^{6} \alpha_i \Delta C_{it} + \sum_{i=1}^{6} \left( \beta_i - \frac{dot.espe_{it}}{C_{it}} \right) C_{it} = \sum_{i=1}^{6} \alpha_i \Delta C_{it} + \left( \sum_{i=1}^{6} \beta_i C_{it} - dot.espe_t \right)$$

Regarding tax treatment, general provisions are tax-deductible up to 1 of the increase in gross loans, as long as they are not mortgages. Non-deductible amounts (i.e., those above that threshold) are accounted for as deferred tax assets, because they will become specific provisions in the future, and therefore deductible, when the impairment is assigned to an individual loan. Tax deductibility has made dynamic provisions more popular among banks. Nevertheless, the Spanish experience shows that they can still be implemented even if they are not fully tax-deductible.

Based on the simulation of a lending cycle with a recession in the middle period, Saurina (200 b) shows that at the peak of the recession provisions (including dynamic provisions) would be 40 lower than traditional provisions, while during good periods, both before and after the recession, the amount of provisions would be higher when dynamic provisions are used. It goes without saying that a different set of alpha and beta parameters would produce a different provisioning profile.

Chart 1 shows the flow of net loan loss provisions (specific plus general) for Spanish deposit institutions.[10] As can be seen, before the introduction of the

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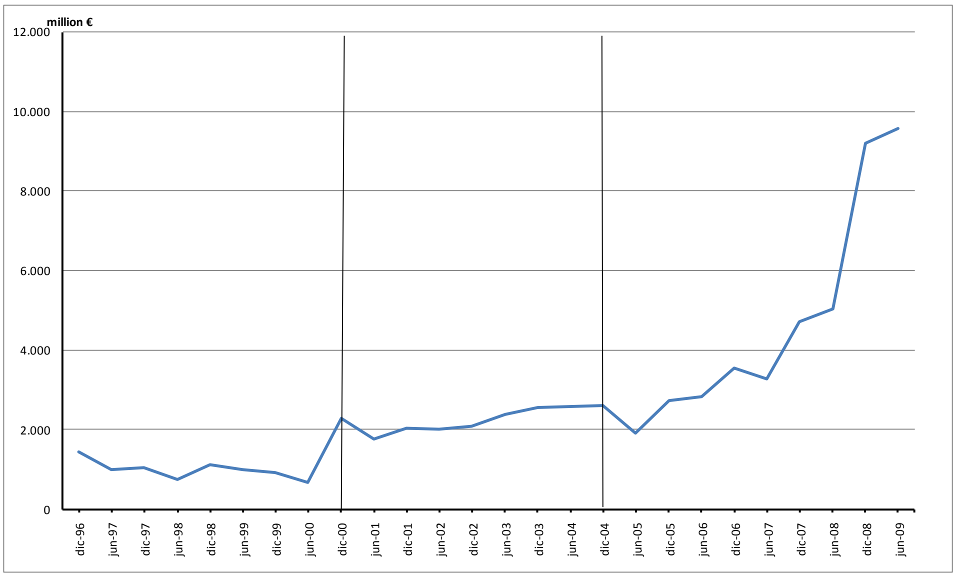
to small and medium-sized firms; v) Medium-high risk: consumer durables financing; and finally, vi) High risk: credit card exposures and overdrafts.

[10] The term "net" acquires its full "meaning" in 2008 when the contribution of the generic provision to the total amount of provisions becomes negative as a result of the prevailing adverse

statistical provision in mid-2000, the total loan loss provision showed a slightly decreasing trend. Once the statistical provision was implemented, the trend in provisions was clearly reversed. The changes introduced in 2005 did not change the previous trend, until non-performing loans started to increase significantly.

Chart 1. Amount of total net loan loss provisions (flow)




Source: *Banco de España*

A system of dynamic provisions has to be implemented in an expansionary phase of the economy. Conceptually, because this is when credit risk builds up and, practically, because banks need to build up a buffer to be used when the recession arrives, i.e., when credit losses materialize *ex post* in specific loans. Moreover, this is precisely what determines its macroprudential dimension and utility.

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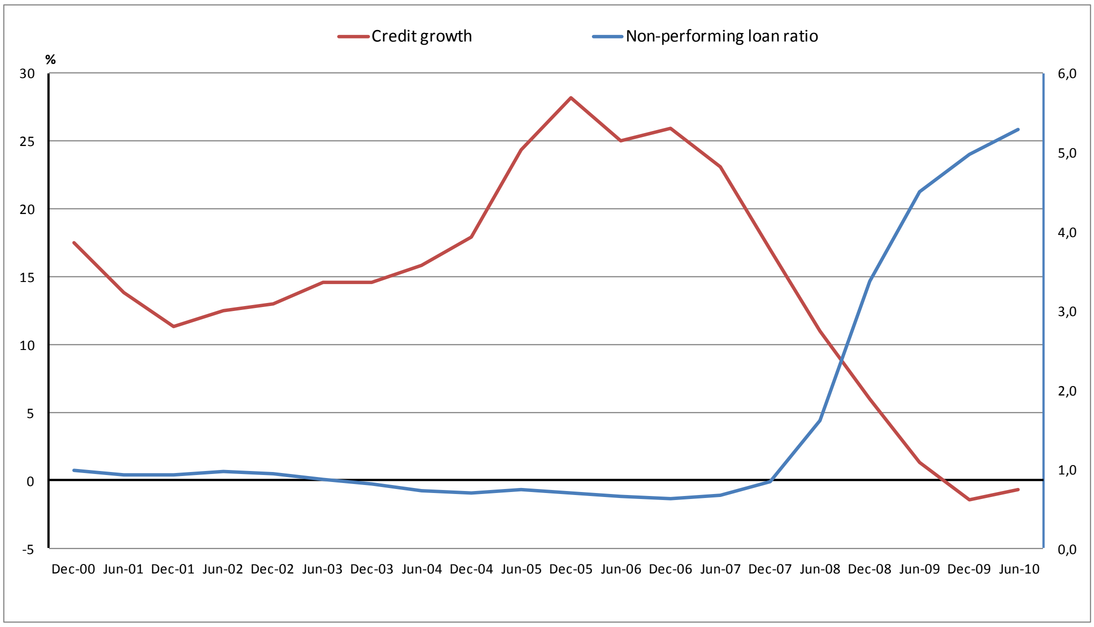
economic conditions. Since then, total provisions have been computed as the difference between positive and increasing specific provisions and negative general provisions. The countercyclical dimension of the general provision thus manifests itself by offsetting the total amount of provisions to be charged against the profit and loss account.

Chart 2. Credit growth and non-performing loan ratio. Deposit institutions




Source: *Banco de España*

As explained in the introduction, in the period before the statistical provision was introduced, credit had been moving in a high and increasing trend, as the economy had robustly pulled out of the recession of the early nineties. The subsequent economic expansion allowed banks to have low levels of non-performing loans and, thus, to experience a declining path in the level of the ratio of specific loan loss provisions to total loans. The credit expansion and the benign economic conditions extended over a period of more than ten years. But, by the second half of 200 , economic growth and lending started a significant slowdown, with a sharp rise in the non-performing loan (NPL) ratio in 200 as the Spanish economy headed for its deepest recession in more than 0 years (see Chart 2).

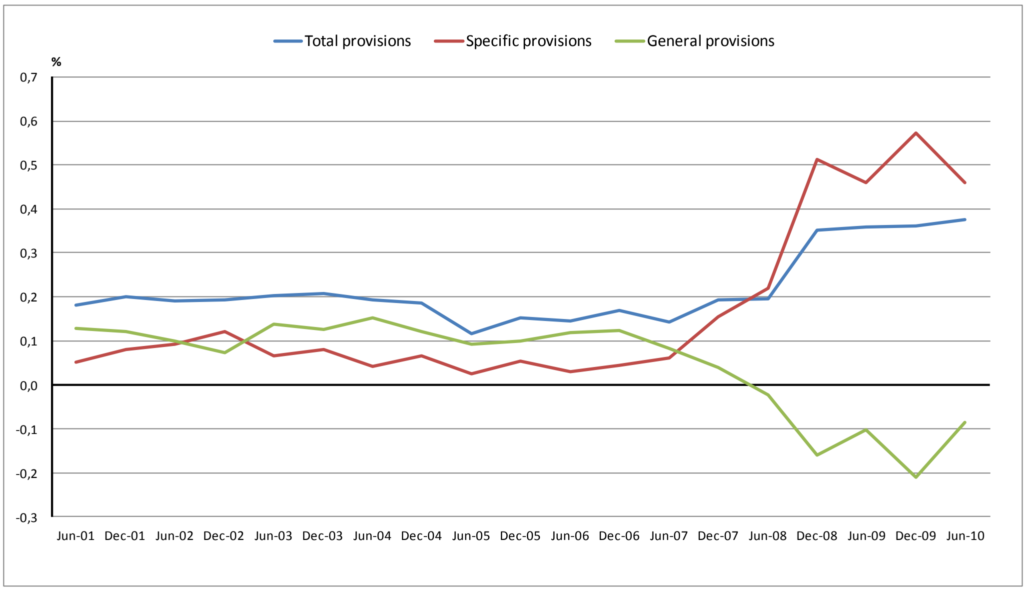
Using data from July 2000 to June 2010, we show the mechanism and functioning of dynamic provisions, in particular the build-up of the

countercyclical provision and its use in the downturn. It is important to clarify that the data and Charts provided are based on individual bank data. Before 2005, for comparability issues, dynamic (general) provisions are calculated as the sum of the general plus the dynamic provision. When referring to provisions as such, we mean the flow of provisions, otherwise mention will be made of the consideration of provision funds (the stock of provisions).

Chart 3 shows the provisions in relative terms (i.e. as the percentage of total credit to the private sector). Specific provisions (over total loans granted) represented a very small share of credit exposures (around 0.05 ) during the expansion years, while general provisions were more than twice that figure during the same period. However, in 200 , due to the change in general economic conditions, a deep and rather sharp change took place in the lending cycle, and specific provisions increased very rapidly, while general provisions moved into negative territory, with the final result of a much less pronounced increase in total provisions.

Chart 3 precisely illustrates the countercyclical nature of dynamic provisions. If Spain had had only specific provisions, in around two years these would have jumped from around 0.05 of total credit to more than 0.5 (a tenfold increase). However, current total provisions have evolved from a minimum of around 0.15 of total loans two/three years ago to a level around 0.35 currently. Loan loss provisions are, therefore, still increasing and have an impact on the profit and loss account of banks, but much smaller thanks to the countercyclical mechanism which contributes to the resilience of the whole banking sector. This is the macroprudential dimension of dynamic provisions.

Chart 3. Loan Loss Provisions (flow) as a percentage of total loans. Deposit institutions.



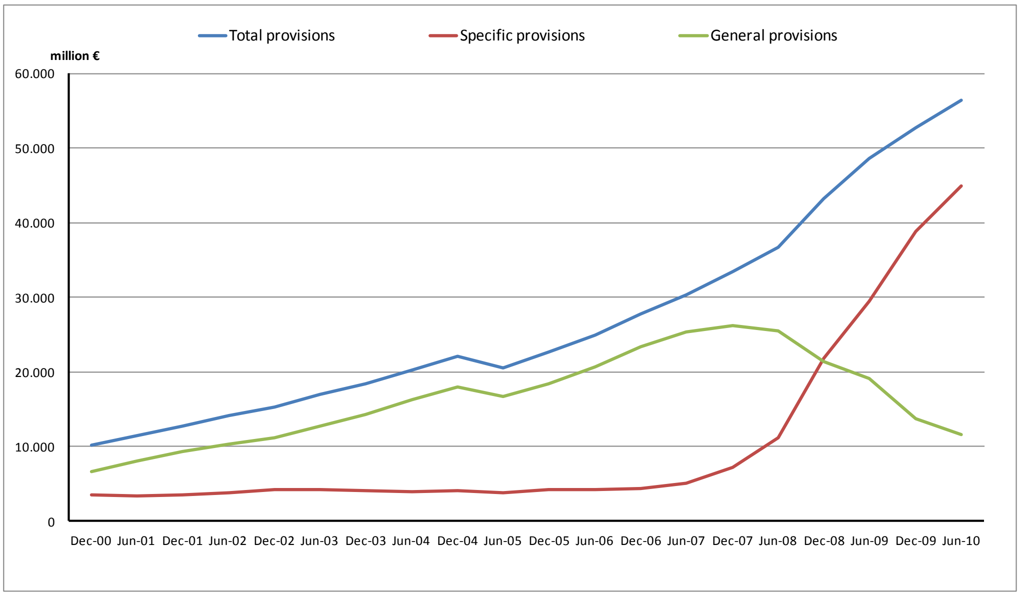

Source: *Banco de España*

The loan loss provision fund (stock) has evolved accordingly (Chart 4). The countercyclical nature of dynamic provisions can also be seen in the changes in the general fund which starts to be depleted as the slowdown gains momentum. The buffer of provisions accumulated in the expansion phase is ready to be used in the downturn. It was not the idea of the regulator to build up a *permanent* buffer of provisions. On the contrary, the idea was to cover the latent risk built up in the upturn and to use the provisions accumulated in good times when those risks materialize *ex post* in losses on specific loans. As already mentioned, there is now no minimum for the general fund. Therefore, the general fund built

up during the upturn can be fully depleted as specific provisions keep growing as a result of the increase in non-performing loans.

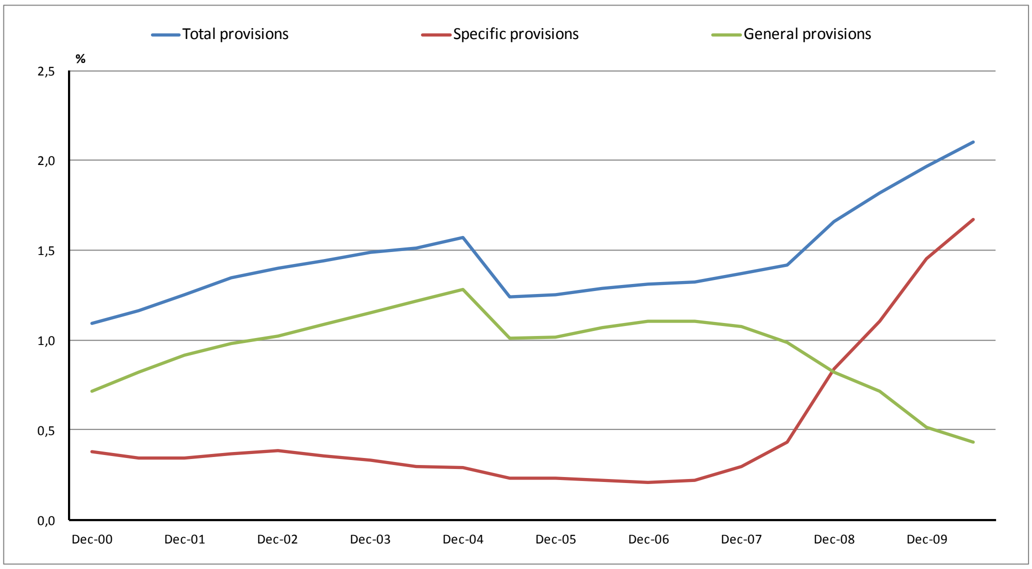
It is interesting to study the stock of provisions in relative terms. The specific provision fund relative to problem loans is around 50 for almost the whole period analyzed, while the most relevant changes are for the general fund, as expected. During the upturn, the coverage of doubtful loans with general loan loss provisions reached a maximum of around 250 , which reflects the very low level of problem loans in good times as well as the fact that the latent credit risk in banks' balance sheets had not yet materialized in individual loans. As those losses materialized, the coverage of the general fund relative to problem loans started to decline sharply, because the former increased significantly, forcing the latter to start to be depleted. Following the same trend, the stock of total provisions also declined. Although much smaller than in previous years, the total provision fund currently offers an acceptable level of coverage, taking into account the average loss given default expected for the aggregated Spanish bank portfolios.

Chart 4. Breakdown of provision funds (stock) into specific and general.



Source: *Banco de España*

Chart 5. Provision funds (stock) over total loans




Source: *Banco de España*

In terms of total loans, Chart 5 shows that a countercyclical loan loss provision smoothes the total loan loss provision coverage. The specific provision fund relative to total loans has increased more than six-fold over the last two years, whereas the total loan loss provision fund in relation to total loans has only increased by 50 as a result of the application of the general provisions set up for this purpose. Again, this shows the macroprudential aspect of dynamic provisions, while they still increase during recessions in relative terms (i.e., the total stock of provisions is currently rising).

Total loan loss provisions at a consolidated level at the end of 200 , before dynamic provisions started to be depleted, were 1.33 of total consolidated

assets (excluding branches from EU countries, which are not subject to dynamic provisioning). This figure compares with a ratio of 5. between bank capital and those total assets. Therefore, the total loan loss provision buffer meant an additional 2 .1 of core capital or an addition of 2 . to the Tier 1 figure. It should be taken into account that Spanish banks did not have conduits or SIVs, thus the amount of off-balance sheet assets was much more limited than in other banking systems, which reinforces the importance of the buffer coming from loan loss provisions. Not all consolidated assets are subject to credit risk and, therefore, do not require a loan loss provision. If we focus on the assets which require general loan loss provisions, at the end of 200 Spanish banks at a consolidated level had 1.20 of general provisions for total credit granted. General provisions were 3.2 of total loan loss provisions at that time. More specifically, if we focus on those exposures subject to positive general or dynamic provisioning requirements (i.e., excluding exposures to the public sector as well as interbank exposures for which both $\alpha$ and $\beta$ parameters are 0 ), the ratio of general provisions to credit subject to positive dynamic provisioning requirements was 1.44 at the end of 200 at a consolidated level. Arguably, the relevant benchmark to assess the impact of Spanish dynamic provisions is not consolidated data but rather individual data centered on the Spanish lending market. The ratio of general provisions to total credit subject to the general provision at the end of 200 for individual balance sheets was 1.22 . If we exclude exposures with a 0 weighting, the coverage ratio reaches 1.5 . For non-consolidated data in Spain, the general provisions were . of total provisions at the end of 200 .

Another interesting point is the impact on the profit and loss account. The impact of the flow of general provisions on net operating income was material, being around 15 during the period before the general provision fund started to be used. This explains why banks are usually not much in favor of them in an expansionary phase. When dynamic provisions are used (i.e., when the general fund is being drawn down), the impact on net operating income is also very significant and close in terms of relative magnitudes, helping banks to protect their capital during recessions.

There may be significant heterogeneity across banks regarding dynamic loan loss provisions. In fact, some banks have already used a significant portion of their general provisions while others have only just started to deplete them. For instance, the distribution of the coverage of loan portfolio by general provisions shows a significant dispersion around the mean. Since dynamic or general loan loss provisions are driven by a fixed formula, how they evolve over time will depend both on the increase in non-performing loans (and specific provisions), and on the decline in credit growth. As a result, those banks that pursued riskier credit policies will face larger specific provisions and will deplete their general provisions much faster than more conservative banks.

All in all, we have shown in practice, with real bank data, how countercyclical loan loss provisions are accumulated during the upturn and how they start being used in the downturn, along with their effects on total provisions.

## 3. DATA

In this section we discuss the datasets that underpin our identification strategy. Spain offers an ideal experimental setting for identification, not only because of the dynamic provisioning experiments that took place, but also since its economic system is banking dominated and, especially, through its exhaustive banking credit register. Banks continue to play a key role in the Spanish economy and in the financing of the corporate sector. In 200  for example their deposits (credits) to GDP equaled 132 percent (1 4 percent). Most non-financial firms had no access to bond financing and the securitization of commercial and industrial loans is still very low (4.  percent in 200 ).

The exhaustive bank loan data, we have access to, comes from the Credit Register of the Banco de España (CIR), which is the supervisor and regulator in Spain of the banking system. We analyze the records on the granted business loans present in the CIR, which contains confidential and very detailed information at the loan level on virtually all loans granted by all banks operating in Spain. In particular, we work with commercial and industrial (C&I) loans ( 0 percent of total loans), granted to non-financial publicly limited and limited liability companies (that account for around  5 percent of all firms) by commercial banks, savings banks and credit cooperatives (that account for more than  5 percent of the entire Spanish financial system). We use all the business loans that correspond (e.g. in 200 ) to more than 100,000 firms and 1 5 banks in the database.

The CIR is almost comprehensive, as the monthly reporting threshold for a loan is only  ,000 Euros. Given that we consider only C&I loans, this threshold is very

low which alleviates any concerns about unobserved changes in bank credit to small and medium sized enterprises. We match each loan both to selected firm characteristics – in particular firm identity, industry, location, the level of credit and defaults, firm size, age, capital, liquidity, profits, tangible assets – and to bank balance-sheet variables (size, capital, liquidity, NPLs, profits, real estate exposure). Both loan and bank data are owned by the *Banco de España* in its role of banking supervisor. We use these data to analyze the relevant effects of the introduction of dynamic provisioning and the crisis on measures of credit.[11]

## 4. RESULTS

We start studying the initial shock, i.e., the introduction of dynamic provisions in July 2000 on credit availability, and then we analyze whether the provision buffers that banks had just before the start on the recent crisis helped in supporting credit availability during the crisis.

### 1. Buffers in good times

As explained in the Introduction and Section 2, the *Banco de España* introduced new provisions in July 2000, which were enforced at the end of September 2000. Our main variable is *Buffers*, which is defined as the new provisions stemming from the *Banco de España* formula for the dynamic provisions (see Section 2) over total assets (or total credit?). We calculate the variable at the time of the initial shock. The variable *Buffers* has an average of 0.4 , a median of 0.4 , the standard deviation is 0.0 , the minimum value is 0.12 and the maximum is 1.13.

[11] In the next version we will incorporate the summary statistics of all variables.

The experiment that constituted the introduction of dynamic provisions was exogenous but not random. Still our main bank variable *Buffers* is not correlated in 2000 with bank size, profits, liquidity, NPL or capital ratio. It is negatively correlated with real estate exposure as mortgages have a lower coefficient on the formula than loans to SME (see Section 2). Conditional on the other bank characteristics, commercial and cooperative banks have higher buffers than saving banks in 2000. In our main regressions we will control for bank characteristics in a parametric way and, in some robustness, in a non-parametric way with firm*bank-type fixed effects, where we compare lending by different banks of one category (say savings banks or *cajas*) to the same firm at the same time (not reported).

Banks with higher buffers do not seem to lend to different type of firms, at least based on firm observables, in particular on firm size, capital, age, liquidity, profits, tangible assets and risk (proxied by previous credit history). Nor they seem to apply different lending conditions in terms of loan size and maturity. The only different condition is that they ask for less collateral, which most probably is because less collateralized loans imply less need of buffers. All in all, despite the non-random nature of the experiment, banks with different levels of buffers are not very different in terms of bank, firm and loan characteristics. Still there could be some unobservable differences, e.g., unobserved firm characteristics and, hence, we control in our main (benchmark) regression by firm*time fixed effects, in addition to bank characteristics.

We start by analyzing the impact of (new bank) buffers on the volume of credit that is granted. We analyze first the change in log credit volume between end of

2000:I and end of 2001:IV (see Table 1) and then the change in log credit volume from *t* to end of 2001:I, where *t* goes from 1 :III to 2003:IV (see Figures 1 and 2 where we plot the time-varying elasticities of *Buffers* on credit volume for each quarter *t*). In Table 1 we show all the results with the different combinations of controls: bank characteristics (size, capital, liquidity, ROA, NPLs, bank type, real estate exposure), observable firm characteristics (size, age, capital, liquidity, tangible assets, credit history, ROA, province and industry), firm fixed effects (to account for both observed and unobserved firm characteristics) and loan characteristics (maturity and collateral).[12]

As explained before, our benchmark regression includes bank characteristics and firm fixed effects, and Figures 1 and 2 plot for each possible quarter *t* the coefficients of *Buffers* on credit volume controlling for both sets of variables. In Table 2 we analyze other changes in loan conditions, in particular whether loans are short-term (lower than 1 year) or collateralized.[13] We also check the change in loan cost (loan price and covenants) proxied by the change in drawing down of committed loans. If the credit cost is higher from one bank vis-à-vis another bank for a firm in a particular quarter, then we should expect that the firm draws down a committed loan from the bank with a lower cost.

We find robust evidence showing that banks with higher buffers required by the new regulation that came into force in the third quarter of 2000 reduce credit availability for firms (as compared to less affected banks), both in terms of

[12] In robustness we also include past credit volume and analyze subgroups of firms such as real estate firms, non-real estate firms or SME firms.
[13] For the sake of brevity we do not report all the possible combinations of controls in Table 2 and Figures 1 and 2; nevertheless, the unreported results are very similar to those we report.

credit volume, cost, maturity, and collateral.[14] The results are robust to the successive inclusion of bank, firm and loan controls (notably firm*time fixed effects) and the limitation of the analysis to subgroups of firms such as non-real estate firms, real estate firms, or SMEs.

Moreover, when we measure the time-period (quarter) elasticities of the new regulation on credit volume over 1 :III-2003:IV, we find that there was no statistical effect until the end of the second quarter of 2000 (when the law came into force) but a strong economic effect in third quarter of 2000 (when the new law was binding); the elasticities remain high afterwards in absolute value. The economic effects suggest that an increase of 1 standard deviation of *Buffers* reduces the committed volume of credit availability by 3. .

Finally, in Table 3 and Figures 3 and 4, we use firm-level data to analyze credit substitution by firms within the banking system (i.e., firms could try to switch from more to less affected banks by the dynamic provision shock).[15] Table 3 of firm-level data is the equivalent to Table 1 of firm-bank level data and Figures 3 and 4 to Figure 1, where *average buffer* is the weighted average of the *Buffers* of the banks that were lending to the firm before the policy shock. In Table 3 and Figure 3 we control for the fixed effects of the main bank of each firm, whereas in Figure 4 we do not control for these main bank fixed effects.

We find that firms with higher ex-ante borrowing from banks more affected by the dynamic provisions have lower credit availability; however, the elasticities

[14] The increase in retained profits stemming from dynamic provisions was not offset by a decrease in bank capital, thus the increase in total bank capital (Tier 1 and 2) of the new policy was binding. A possible reason is that, despite the presence of some capital buffers, these are relatively small and banks may want to maintain them to avoid regulatory costs.
[15] In the next version of the paper we will also check other sources of debt.

are considerable lower of those stemming from the firm-bank level data, thus suggesting a strong – though not perfect – ability of firms to substitute credit from the more affected banks towards the less affected ones. The economic effects suggest that an increase of 1 standard deviation of *Average Buffers* decreases the committed volume of credit availability by 1.5 .

In the next version of the paper we will also analyze real effects in terms of firm investment, sales, profits, total debt and employment, and whether the credit reduction was stronger for some type of firms, for example riskier firms, to understand the economic rationale behind these effects (e.g., reduction of moral hazard by banks).

## 2. Buffers in bad times

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(proxied by previous credit history). Nor do they seem to apply different lending conditions in terms of loan size, collateral and maturity.

Tables 4, 5 and are the equivalent to Tables 1, 2 and 3, except that the time span is now 200 :II to 200 :IV. Figures 5 and are equivalent to 1 and 2 and Figures and are equivalent to 3 and 4, where we analyze changes in loan conditions between quarter *t* and 200 :II. There are no effects before 200 :II (not reported).

Conditioning on bank controls, we find robust evidence that banks that had provisioned more due to dynamic provisioning before the start of the crisis (higher provision buffers in 200 :IV) support – during the crisis – the availability of credit to firms (in terms of both credit volume and cost) more than banks had provisioned less (see Tables 4 and 5). The results are robust to the successive inclusion of key firm and loan characteristics (notably firm*time fixed effects) and to the subsampling of credit subgroups as non-real estate firms, real estate firms, or SMEs.

Moreover, when we measure the quarter elasticities of the ex-ante provision buffers on credit availability over 200 :II-200 :IV, we find that there were no economic effects until 200 and 200 (see Figures 4 and 5). The economic effects suggest that an increase of 1 standard deviation of ex-ante provision buffers increases credit availability during the crisis by . It is important to note that the economic effects of the bank variables such as capital, profits, size and others are small compared to those of the countercyclical buffers, both during the crisis and also during the good times.

Finally, in the firm-level data we find that firms with higher ex-ante borrowing from banks with lower ex-ante provision buffers had lower credit availability during the crisis. Moreover, the elasticities are not significantly reduced as compared to the firm-bank level data, thus suggesting a limited ability for firms to substitute credit during the crisis by switching from banks with lower ex-ante buffers to banks with higher ex-ante buffers. As the comparison between the good and crisis times show, switching banks during a crisis is much more difficult, thus suggesting that not only the buffers of the whole banking system but also those of each individual bank matters.

In the next version of this paper we will also study (as in the 2000 shock) both real effects and firm heterogeneity in credit availability. Moreover, we will instrument the part of provisions in 200 :IV that should come from the *Banco de España* formula, thus cleaning it from voluntary buffers by banks which may reflect bank prudence.[1] This endogenous part may explain why despite of higher credit availability in terms of volume and cost, we find stronger lending conditions for loan maturity and collateral from banks with higher ex-ante buffers. We will also study the extensive margin of new lending with loan applications. We will also exploit policy shocks during the crisis where *Banco de España* allow banks to go bellow the lower limit in the stock of provisions stemming from dynamic provisions (generic provisions).[1]

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[1] The voluntary part is costly for banks since it is not tax deductible.
[1] The floor was 33 of the latent loss.

## 5. CONCLUSIONS

A crucial issue for macroprudential policy is to avoid the negative externalities from the financial system to the real economy. Both during good times when risk, stemming from "excessive" credit supply, is built into the balance sheets of banks as well as during bad times when distressed banks contract the supply of credit to firms with good investment opportunities. A solution proposed by policymakers and academic theory alike is countercyclical bank capital buffers.

In this paper we identify how countercyclical bank capital buffers determine credit supply. Spain offers an excellent setting for identification. First, policy experiments with dynamic provisioning provide exogenous bank-specific shocks to countercyclical buffers. Second, a comprehensive credit register and the possibility to employ firm-time fixed effects to also account for unobserved time-varying firm heterogeneity permit the identification of credit supply.

Our results suggest that countercyclical buffers mitigate bank pro-cyclicality. Buffers contract credit availability (volume and cost) during good times, but expanded it during the recent crisis. While bank-level effects are always economically strong, firms are especially affected during crisis times when switching from banks with low to high buffers is likely to be difficult.

Our findings hold important implications for macroprudential policy. Our results suggest that bank pro-cyclicality can be reduced with higher bank capital buffers in good times. These buffers reduce credit supply in good times (when the high bank risk is built into the bank balance sheets) and, moreover, allows banks to have buffers in crisis times to support lending without government help (bail-outs and very expansive monetary policy). The countercyclical bank capital

buffers are in Basel III and our results support the rationale behind expressed both in Basel and the G-20 on these issues. Moreover, our results show these can be achieved using dynamic provisioning (Tier 2 capital).

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Table 1. Change in Loan Conditions from 2000endQ1 to 2001endQ4

| | Δlog Commitment | | | | | | | ΔLog Drawn | Loan Droppe |
|---|---|---|---|---|---|---|---|---|---|
| | ( 1) | ( 2) | ( 3) | ( 4) | ( 5) | ( 6) | ( 7) | ( 8) | ( 10) |
| Buffers | -0.411 *** | -0.458 *** | -0.469 *** | -0.511 *** | -0.519 *** | -0.484 *** | -0.414 *** | -0.548 *** | 0.383 *** |
| | ( .14) | ( .126) | ( .121) | ( .128) | ( .137) | ( .112) | ( .108) | ( .115) | ( .052) |
| Bank controls | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Pronvince & Regional Fixed effects | No | No | Yes | Yes | Yes | -- | -- | -- | -- |
| Firm controls | No | No | No | Yes | No | No | No | No | No |
| Multiple relationships | No | No | No | No | Yes | Yes | Yes | Yes | Yes |
| Firm Fixed effects | No | No | No | No | No | Yes | Yes | Yes | Yes |
| Loan controls | No | No | No | No | No | No | Yes | No | No |
| Cluster/No. of clusters | Bank/182 | Bank/182 | Bank/182 | Bank/177 | Bank/182 | Bank/182 | Bank/182 | Bank/181 | Bank/182 |
| N | 612,775 | 612,775 | 612,775 | 294,046 | 374,670 | 374,670 | 374,670 | 326,402 | 573,179 |

Table 2. Change in Loan Conditions from 2000endQ1 to 2001endQ4

| | Drawn to Committed Ratio | | | Short-Term Maturity Rate (<1 year) | | | Collateralization Rate | | |
|---|---|---|---|---|---|---|---|---|---|
| | ( 1) | ( 2) | ( 3) | ( 4) | ( 5) | ( 6) | ( 7) | ( 8) | ( 9) |
| Buffers | -0.299 *** | -0.250 *** | -0.246 *** | 0.686 *** | 0.703 *** | 0.702 *** | 0.032 | 0.009 | 0.111 *** |
| | ( .057) | ( .033) | ( .035) | ( .254) | ( .177) | ( .182) | ( .03) | ( .019) | ( .031) |
| Bank controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Pronvince & Regional Fixed effects | Yes | -- | -- | Yes | -- | -- | Yes | -- | -- |
| Firm controls | No | No | No | No | No | No | No | No | No |
| Multiple relationships | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm Fixed effects | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes |
| Loan controls | No | No | Yes | No | No | Yes | No | No | Yes |
| Cluster/No. of clusters | Bank/181 | Bank/181 | Bank/181 | Bank/182 | Bank/182 | Bank/182 | Bank/182 | Bank/182 | Bank/182 |
| N | 218,805 | 218,805 | 218,805 | 374,670 | 374,670 | 374,670 | 374,670 | 374,670 | 374,670 |

Table 4. Change in Loan Conditions from 200 endQ2 to 200 endQ4

| | Δlog Commitment | | | | | | | ΔLog Drawn | Loan Droppe |
|---|---|---|---|---|---|---|---|---|---|
| | ( 1) | ( 2) | ( 3) | ( 4) | ( 5) | ( 6) | ( 7) | ( 8) | ( 10) |
| Generic Fund/Total Assets | 0.083 | 0.182 * | 0.192 ** | 0.251 ** | 0.265 ** | 0.307 *** | 0.350 *** | 0.333 *** | -0.174 *** |
| | ( .075) | ( .094) | ( .095) | ( .115) | ( .129) | ( .111) | ( .112) | ( .112) | ( .054) |
| Bank controls | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Pronvince & Regional Fixed effects | No | No | Yes | Yes | Yes | -- | -- | -- | -- |
| Firm controls | No | No | No | Yes | No | No | No | No | No |
| Multiple relationships | No | No | No | No | Yes | Yes | Yes | Yes | Yes |
| Firm Fixed effects | No | No | No | No | No | Yes | Yes | Yes | Yes |
| Loan controls | No | No | No | No | No | No | Yes | No | No |
| Cluster/No. of clusters | Bank/175 | Bank/175 | Bank/175 | Bank/175 | Bank/174 | Bank/174 | Bank/174 | Bank/174 | Bank/175 |
| N | 931,125 | 931,125 | 931,125 | 488,932 | 554,243 | 554,243 | 554,243 | 496,141 | 560,508 |

Table 5. Change in Loan Conditions from 200 endQ2 to 200 endQ4

| | Drawn to Committed Ratio | | | Short-Term Maturity Rate (<1 year) | | | Collateralization Rate | | |
|---|---|---|---|---|---|---|---|---|---|
| | ( 1) | ( 2) | ( 3) | ( 4) | ( 5) | ( 6) | ( 7) | ( 8) | ( 9) |
| Generic Fund/Total Assets | 0.047 | 0.053 ** | 0.047 * | 0.171 *** | 0.182 *** | 0.183 *** | 0.013 | 0.012 | 0.049 *** |
| | ( .036) | ( .025) | ( .025) | ( .05) | ( .036) | ( .033) | ( .021) | ( .013) | ( .012) |
| Bank controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Pronvince & Regional Fixed effects | Yes | -- | -- | Yes | -- | -- | Yes | -- | -- |
| Firm controls | No | No | No | No | No | No | No | No | No |
| Multiple relationships | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm Fixed effects | No | Yes | Yes | No | Yes | Yes | No | Yes | Yes |
| Loan controls | No | No | Yes | No | No | Yes | No | No | Yes |
| Cluster/No. of clusters | Bank/172 | Bank/172 | Bank/172 | Bank/174 | Bank/174 | Bank/174 | Bank/174 | Bank/174 | Bank/174 |
| N | 389,492 | 389,492 | 389,492 | 554,243 | 554,243 | 554,243 | 554,243 | 554,243 | 554,243 |

Figure 1. Time-varying elasticities of buffers on credit drawn

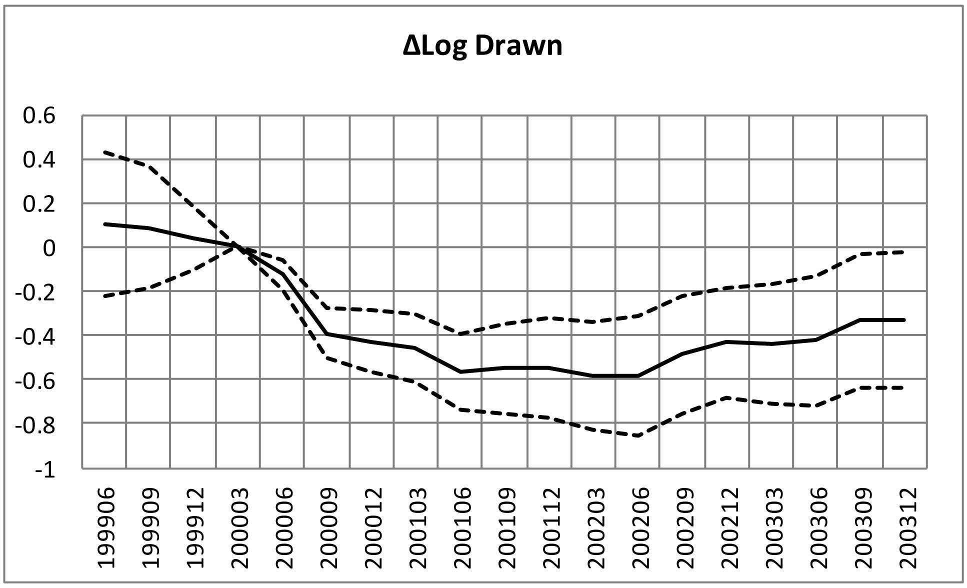


Figure 2. Time-varying elasticities of buffers on credit drawn at the firm level

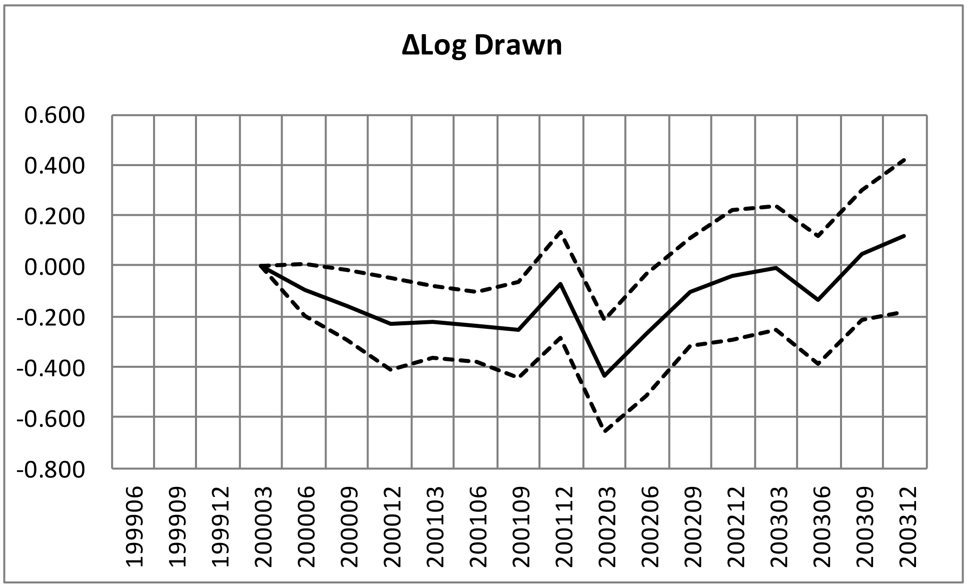

Figure 3. Time-varying elasticities of buffers on credit drawn

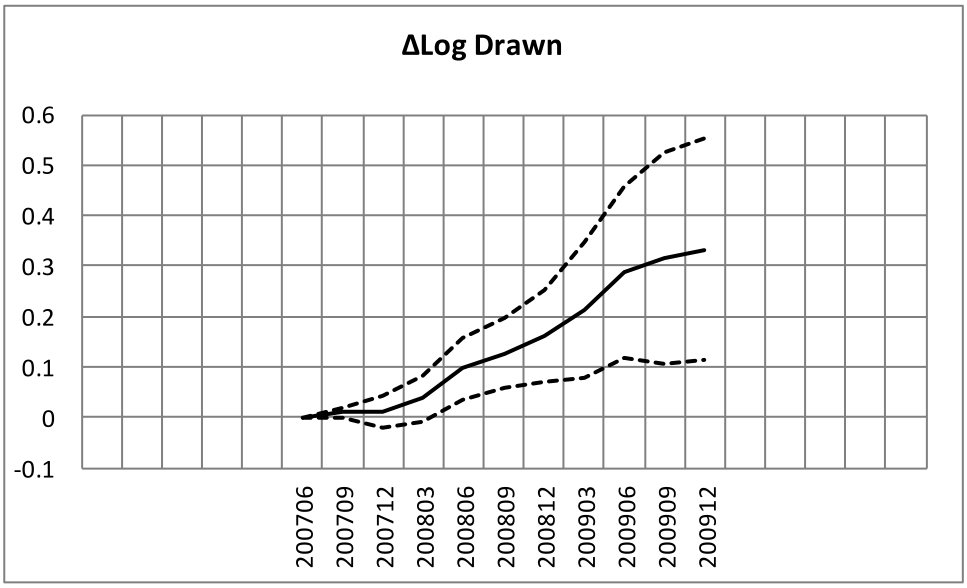


Figure 4. Time-varying elasticities of buffers on credit drawn at the firm level