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Gabriel Jiménez y Jesús Saurina(**)

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(**) Address for correspondence: Jesús Saurina; c/ Alcalá, 48, 28014 Madrid, Spain. Phone: + 34 91 338 5080; e-mail: jsaurina@bde.es

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Abstract

This paper finds strong empirical support of a positive, although quite lagged, relationship between rapid credit growth and loan losses. Moreover, it contains empirical evidence of more lenient credit terms during boom periods, both in terms of screening of borrowers and in collateral requirements. Therefore, we confirm the predictions from theoretical models based on disaster myopia, herd behaviour institutional memory and agency problems between banks' managers and shareholders regarding the incentives of the former to engage in too expansionary credit policies during lending booms. The paper also develops a prudential tool, based on loan loss provisions, for banking regulators in order to cope with the former problem.

JEL: E32, G18, G21.

Key words: credit risk, lending cycles, loan loss provisions, bank capital, collateral.

1 Introduction

Banking supervisors, through many painful experiences, are quite convinced that banks' lending mistakes are more prevalent during upturns than in the midst of a recession.[1] In good times both borrowers and lenders are overconfident about investment projects and their ability to repay and to recoup their loans and the corresponding fees and interest rates. Banks' over optimism about borrowers future prospects bring about more liberal credit policies with lower credit standards requirements.[2] Thus, some negative net present value projects are financed just to find later the impairment of the loan or the default of the borrower. On the other hand, during recessions, when banks are flooded with non-performing loans and specific provisions, they suddenly turn very conservative and tighten credit standards well beyond positive net present values. Only their best borrowers get new funds and, thus, lending during downturns is safer and credit policy mistakes much lower. Across many jurisdictions and at different points in time, bank managers seem to overweight concerns regarding type 1 lending policy errors (i.e. good borrowers not getting a loan) during economic booms and underweight type 2 errors (i.e. bad borrowers getting financed). The opposite happens during recessions.

Several explanations have appeared in the literature to account for, at first sight irrational, behaviour of banks' managers. Disaster myopia, herd behaviour, agency problems and the institutional memory hypothesis are the main arguments to rationalise fluctuations in credit policies.

Disaster myopia arises when it is impossible to assign a probability to a future event [Guttentag and Herring (1984)]. Such an event might be the result of a change in the economic regime, a change in the regulatory framework or a natural or man-made disaster. If managers can not discount the effects of a future negative event, then they may be more prone to credit expansion and, when the event happens, drastically cut lending.

Secondly, herd behaviour [Rajan (1994)] explains why banks' managers are prepared to finance negative NPV projects during expansions. Credit mistakes are judged more leniently if they are common to the whole industry. Moreover, a bank manager that systematically losses market share and that underperforms their competitors in terms of earnings growth increases its probability of being sacked. Thus, managers have a strong incentive to behave as their peers which, of course, at an aggregate level enhances lending booms and recessions. Reputational and short term objectives are prevalent and might explain why banks are prepared to finance negative NPV projects during expansions that, later on, will become non-performing loans.

The classical principal-agency problem between bank shareholders and managers can also feed excessive volatility into loan growth rates. Managers, once they obtain a reasonable return on equity for their shareholders, may engage in other activities that depart from firm value maximization and focus more on managers' rewards. One of these activities might be excessive credit growth in order to increase the social presence of the bank (and its managers) or the power of managers in a continuously enlarging organisation [Williamson (1963)]. If managers are rewarded more in terms of growth objectives instead of profitability targets, incentives to rapid growth might also be the result. The former has been

1. See, for instance, Crockett (2001), Caruana (2002) or Ferguson (2004).

2. A loose monetary policy can also contribute to over optimism through excess liquidity provision.

documented earlier by the expense preference literature and, more recently, by the literature that relates risk and managers incentives.[3]

More recently, Berger and Udell (2003) have developed a complementary hypothesis in order to explain the markedly cyclical profile of loans and non-performing loan losses. They call it the institutional memory hypothesis and, essentially, it states that as time passes since the last loan bust, loan officers become less and less skilled in order to avoid granting loans to high risk borrowers. That might be the result of two complementary forces. First of all, the proportion of loan officers that experienced the last bust decreases as the bank hires new, younger, employees and the former ones retire. Thus, there is a loss of learning experience. Secondly, some of the experienced officers may forget about the lessons of the past and the more far away is the former recession the more they will forget.[4]

The four former arguments are based on imperfect information,[5] either in credit markets or between managers and bank shareholders. All of them might get worse with increasing competition among banks or between banks and other financial intermediaries. Strong competition erodes net interest and gross income margins as both loan and deposit interest rates get closer to the interbank rate. To compensate the fall in profitability, bank managers increase asset growth (i.e. loan growth) and that can come at the expense of the (future) quality of their loan portfolios. Nevertheless, that will not impact immediately on problem loans, so it might encourage further loan growth. Credit growth satisfies managers' other interests (expense preference, power, status, etc.) and, even if it goes beyond reasonable levels, it might still do not trigger a response from them since they are subject to disaster myopia and fading memories of the last bust.

Finally, collateral might also play a role in fuelling credit cycles. Usually, loan booms are intertwined with asset booms.[6] Rapid increases in land, house or share prices increase the availability of funds for those that can pledge them as collateral. At the same time, the bank is more willing to lend since it has an (increasingly worthier) asset to back the loan in case of trouble. On the other hand, it could be possible that the widespread confidence among bankers results in a decline in credit standards, including the need to pledge collateral. Collateral, as risk premium, can be thought to be a signal of the degree of tightening of individual bank loan policies.

Despite the theoretical developments and the banking supervisors' experiences, the empirical literature providing evidence of the link between rapid credit growth and loan losses is scant.[7] In this paper we produce clear cut evidence of a direct, although lagged, relationship between credit cycle and credit risk. A rapid increase in loan portfolios is positively associated with an increase in non-performing loan ratios later on. Moreover, those loans granted during boom periods have a higher probability of default than those granted during slow credit growth periods. Finally, we show that in boom periods collateral requirements are relaxed while the opposite happens in recessions, which we take it as evidence of looser credit standards during expansions.

Regarding the empirical evidence, the first model contains both macro and micro variables at the bank level in order to explore the relationship between lending growth and ex post credit risk. The second model is entirely based on Credit Register information and

3. For the former, see, among others, Edwards (1977), Hannan and Mavinga (1980), Verbugge and Jahera (1981), Smirlock and Marshall (1983), Akella and Greenbaum (1988) and Mester (1989). For the later, Saunders et al. (1990), Gorton and Rosen (1995) and Esty (1997).

4. Kindleberger (1978) contains the idea of fading bad experiences among economic agents.

5. See Crockett (1997) for a good summary of many of the former arguments.

6. See, Hofmann (2001), Borio and Lowe (2002) and Davis and Zhu (2004).

7. Clair (1992), Kwan and Eisenbeis (1997), Keeton (1999) and Salas and Saurina (2002) are a few exceptions.

focuses on loan by loan operations. To our knowledge, this is the first time that such an empirical study relating credit cycle phase and future problem loans is being carried out. Finally, the analysis of collateral also relies on loan by loan operations.

The three empirical avenues provide similar results: in boom periods, when banks increase their lending at high (by historical terms) speed, the seeds for rising problem loans in the future are being sowed. During recession periods, when banks curtail credit growth, they become much more cautious, both in terms of the quality of the borrowers and the loan conditions (i.e. collateral requirements). Therefore, banking supervisors' concerns are well rooted both in theoretical and empirical grounds and deserve careful scrutiny and a proper answer by regulators. We call the former findings procyclicality of ex ante credit risk as opposed to the behaviour of ex post credit risk (i.e. impaired or non-performing loans) which increases during recessions and declines in good periods.[8] The main issue here is to realise that lending policy mistakes occur in good times and, thus, a prudential response from the supervisor might be needed at those times.

Capital requirements and loan loss provisions are two of the most important prudential tools that banking regulators use in order to reinforce the solvency of individual institutions and the stability of the financial system as a whole. Basel II latest developments have lead to use the capital to cover unexpected losses while loan loss provisions are devoted to cover expected losses. Credit cycle developments mentioned before impact mainly on expected losses. So, it seems that the first regulatory answer would be to cope with credit risk resulting from lending cycles using loan loss provisions. If accounting or whatsoever restrictions render this mechanism not available, Basel II Pilar 2 might be very well suited to accommodate this prudential mechanism in terms of stress testing.[9]

In this paper we develop a new regulatory devise specifically designed to cope with procyclicality of ex ante credit risk. It is a forward looking loan loss provision that takes into account the former empirical results. At the same time, it can be thought of as being based on the concept of stress testing expected losses differently across a credit cycle. Spain already had a dynamic provision (the so-called statistical provision) with a clear prudential bias [Fernández de Lis, Martínez and Saurina (2000)]. The main criticism to that provision (coming from accountants not from banking supervisors) was that resulting total loan loss provisions were excessively "flat" through an entire economic cycle. The new proposal, although sharing the prudential concern of the statistical provision, does not achieve, by construction, a flat loan loss provision through the cycle. Instead, total loan loss provisions are still higher in recessions but they are also significant when credit policies are the most lax and, therefore, credit risk, according to supervisors' experiences and our empirical findings, is entering at a high speed on bank loan portfolios.

The rest of the paper is organised as follows. Section 2 provides the empirical evidence on credit cycles and credit risk. Section 3 explains the rational and workings of the new regulatory tool through a simulation exercise. Section 4 contains a policy discussion and, finally, section 5 concludes.

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8. A thorough discussion of banking regulatory tools to cope with procyclicality of the financial system is in Borio et al. (2001).

9. Wall and Koch (2000) underline the differences in approaches between banking and market regulators regarding provisioning policies. Borio and Tsatsaronis (2004) open a way forward to decouple between the provision of unbiased information to investors and a degree of prudence in banks' behaviour.

2 Empirical evidence on lending cycles and credit risk

This section encompasses three different empirical exercises. First of all, we investigate the relationship between credit growth and problem loans on a bank to bank basis. We control for macro variables and bank specific variables. Secondly, we focus on default probabilities of individual loans. Finally, we analyse collateral requirements depending of the lending cycle position of each bank.

2.1 Problem loan ratios and credit growth

Salas and Saurina (2002) model problem loan ratios as a function of both macro and micro (i.e. bank balance sheet) variables.[10] They find that lagged credit growth has a positive and significant impact on ex post credit risk measures. Here, we follow the former paper in order to disentangle the relationship between past credit growth and current problem loans. Although in spirit the methodology is similar, there are some important differences worth to be pointed out. First of all, we use a longer period which allows us to consider two lending cycles of the Spanish economy. Secondly, we focus more on loan portfolio characteristics (industry and regional concentration and importance of collateralized loans) of the bank rather than on balance sheet variables which are much more general and difficult to interpret. Finally, we take advantage of the information coming from the Credit Register where all banks must inform of all their loans above € 6,000.[11] That allows us to control for bank portfolio characteristics, such as industry and geographical concentration of loans, and for the role played by collateralised loans.[12]

The equation we estimate is the following:

$$\begin{aligned} &NPL_{it} = \alpha NPL_{it-1} + \beta_1 GDPG_t + \beta_2 GDPG_{t-1} + \beta_3 RIR_t + \beta_4 RIR_{t-1} + \\ &\delta_1 LOANG_{it-2} + \delta_2 LOANG_{it-3} + \delta_4 LOANG_{it-4} + \\ &\chi_1 HERFR_{it} + \chi_2 HERFI_{it} + \varphi_1 COLIND_{it} + \varphi_2 COLFIR_{it} + \omega SIZE_{it} + \eta_i + \varepsilon_{it} \end{aligned} \tag{1}$$

where NPL_{it} is the ratio of non-performing loans over total loans for bank i in year t. In fact, we estimate the logarithmic transformation of that ratio [i.e. ln (NPL_{it}/(100-NPL_{it}))] in order to not curtail the range of variation of the endogenous variable. Since problem loans present a lot of persistence, we include the left-hand-side variable in the right-hand-side lagged one year. We control for the macroeconomic determinants of credit risk (i.e. common shocks to all banks) through the real rate of growth of the gross domestic product (GDPG), and the real interest rate (RIR), proxied as the interbank interest rate less the inflation of the period. Both variables are included contemporaneously as well as lagged one year since some of the impacts might take some time to appear.

Our variable of interest is the loan growth rate, lagged 2, 3 and 4 years. A positive and significant parameter for those variables will be empirical evidence supporting the

10. There is a growing interest on the interaction of macro and micro prudential frameworks to analyse financial stability [Borio (2003) and references therein].

11. A detailed description of Banco de España Credit Register can be found in Jiménez and Saurina (2004) and Jiménez et al. (2005).

12. Some papers have focused on the procyclical behaviour of loan loss provisions as a proxy for ex post credit risk [Cortavarria et al. (2000), Bikker and Hu (2002), Laeven and Majnoni (2003) and Pain (2003)]. However, loan loss provisions are subject to substantial discretionary behaviour by bank managers, thus, distorting its content [Collins et al. (1995)].

prudential concerns of banking regulators since the swifter the loan growth the higher the problem loans in the future. That result also provides a rationale for a loan loss provision that takes into account the risk embedded in the point along the cycle in which the loan is granted.

Moreover, we control for risk diversification strategies of each bank. It might be argued that the more geographic or industry diversified is a loan portfolio the lower will be the credit risk. Thus, we would expect a positive sign for the two Herfindahl indexes (one for region, HERFR, and the other for industry, HERFI). However, it can also be argued that banks might exploit their better diversified portfolios in order to increase risk and expected return [Hughes et al. (1996)]. So, we could not see any empirical difference among diversified and concentrated banks since the *ex post* credit risk would be the same. Usually, the size of the bank (SIZE), that is, the market share of the bank in each period of time, is also used as a measure of risk diversification. We include it in the model as a control variable since portfolio diversification has been properly accounted for.

Equation (1) includes also the specialization of the bank in collateralised loans, distinguishing between those of firms (COLFIR) and those of households (COLIND). It is expected to obtain a positive parameter for the former and a negative one for the latter. Collateralised loans to firms are riskier owing to observed information paradigm [Jiménez and Saurina (2004), and Jiménez, Salas and Saurina (2005)] while collateralised loans to households are, mainly, mortgages for buying their houses. Historically, those mortgages carry out low credit risk.

Finally, η_i is a bank fixed-effect to control for idiosyncratic characteristics of each bank, constant along time. It might reflect the risk profile of the bank, the way of doing businesses, etc. ε_{it} is a random error. We estimate model (1) in first differences in order to avoid that unobservable bank characteristics correlated with some of the right-hand-side variables bias the results. Given that some of the explanatory variables might be determined at the same time as the left-hand-side variable, we use instrumental variables through DPD [Arellano and Bond (1988 and 1991)].

All the information from each individual bank comes from the Credit Register run by Banco de España. Table 1 contains the descriptive statistics of the variables. The period analysed covers two credit cycles of the Spanish banking sector (from 1984 to 2002), with an aggregate maximum for NPL around 1985 and, again, in 1993. We focus on commercial and savings banks which represent more than 95% of total assets among credit institutions (only small credit cooperatives and specialised financial firms are left aside). Some outliers have been eliminated in order to avoid that a small number of observations, with a very low relative weight over the total sample, could bias the results. Thus, we have eliminated those extreme loan growth rates (i.e. banks with a growth lower or higher than 5th and 95th percentile respectively).

Results appear in Table 2, first column (model 1). As expected since we take first differences of equation (1) and ε_{it} is white noise, there is first order residual autocorrelation and not second order. Sargan test of validity of instruments is also fully satisfactory. The results of the estimation are robust to heteroscedasticity.

Regarding the explanatory variables, there is persistence in the NPL variable. The macroeconomic control variables are both significant and with the expected signs. Thus, the acceleration of GDP, as well as a decline in real interest rates, brings about a decline in problem loans. The impact of interest rates is much more rapid than that of economic activity. The more concentrated is the credit portfolio in a region the higher the problem loans ratio while industry concentration is not significant. Collateralised loans to households are less risky (10% level of significance), mainly because these are mortgages which in Spain have the lowest credit risk. The parameter of the collateralised loans to firms, although positive, is not significant. The size of the bank does not have a significant impact on the problem loan ratio. We cannot conclude from this that diversification is not worth in terms of reducing credit risk portfolio since HERFR is positive and significant.

Finally, regarding the variables which are the focus of our paper, the rate of loan growth lagged 4 years is positive and significant (at the 1% level). The loan growth rate lagged 3 years is also positive although not significant.[13] Therefore, rapid credit growth today results in lower credit standards that, eventually, bring about higher problem loans.

The economic impact of the explanatory variables is significant. The long run elasticity of GDP growth rate, evaluated at the mean of the variables, is -1.19; that is, an increase of one percentage point in the rate of GDP growth (i.e. GDP grows at 3% instead of at 2%) decreases the NPL ratio by 30.1% (i.e. it declines from 3.94% to 2.75%). For interest rates, a 100 basis point increase brings about a rise in NPL ratio of around 21.6%. Regarding loan growth rates, an acceleration of 1% in the growth rate has a long term impact of a 0.7% higher problem loan ratio.

Given the relevance, from a banking policy point of view, of model 1 results in Table 2, we have performed numerous robustness tests. Those tests strongly confirm the former result of a positive, lagged and significant relationship between loan growth and credit risk.

Model 2 (second column of Table 2) tests for the asymmetric impact of loan expansions and contractions. We augment model 1 with the absolute value of the difference between the loan credit growth of bank *i* in year *t* and its average over time. All model 1 results hold but it can be seen that there is some asymmetry: rapid credit growth of a bank (i.e. above its own average loan growth), increases non-performing loans (i.e. $\alpha+\beta$ is positive and significant at 5%) while slow growth (i.e. below average) has no significant impact on problem loans (i.e. $\alpha-\beta$ is not significant).[14]

If we estimate model 1 augmented with a cubic term (results not shown) in order to test for non-linear effects, credit growth lagged 4 years is not significant (although lagged 3 years is significant at the 10% level), while the cubic term lagged 4 years is significant and positive. This is important because it even enhances the effect of credit growth on the risk profile of the bank. For instance, the semi-elasticity becomes now 1.2%, instead of 0.7%. With respect to the rest of variables included in the model, there is no change either in sign or significance. Autocorrelation and Sargan test are equally satisfactory.

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13. Salas and Saurina (2002), with data spanning from 1985 to1997, found a 3-year lag between problem loans and credit growth. The increase in the lag we report in this paper is mainly the result of the longer time horizon we have. If we considered data up till 2004, the lag is still in 4 years. In any case, the relevant result is the existence of a substantial lag between problem loans and credit growth.

14. Note that in model 1, regression results are the same for the variable rate of growth of loans in bank *i* at year *t* than for the difference between the former variable and the average rate of growth of loans of bank *i* along time. That is because the later term is constant over time for each bank and disappears when we take first differences in equation (1).

If instead of focusing on credit growth of bank *i* (either alone or compared to its average growth rate over time), we look at the relative position of bank *i* in respect to the rest of banks at a point in time (i.e. at each year *t*), we find that (model 3, third column of Table 2) still the relative loan growth rate lagged 4 years has a positive and significant impact of bank *i* non-performing loan ratio. The parameter of relative credit growth lagged 3 years is positive but not significant. The rest of the variables keep their sign and significance.

Model 4 (last column of Table 2) shows that there is asymmetry in the response of non-performing loans to credit growth. When banks expand their loan portfolios at a speed above the average of the banking sector, future non-performing loans increase, while there is no significant effect if the loan growth is below the average.[15]

Finally, the former results are robust to changes in the macroeconomic control variables (not shown). If we substitute time dummies for the change in the GDP growth rate and for the real interest rate, the loan growth rate is still positive and significant in lag 4 (although at the 10% level) and, again, positive although not significant in lag 3. The time dummy parameters reflect quite well the non-performing loan ratio evolution along time: from year 1990 onwards, problem loans increase as the economy slows down, till the maximum in year 1993. From 1994 onwards, loan losses decrease, even further than the level of 1989 (omitted time dummy), until minimum levels the last years of the sample. Now, the geographical concentration of the loan portfolio does not seem to increase problem loans while collateralised loans to households are no more of low risk. That is probably due to the low variability of both variables along time and the use of time dummies that capture a greater amount of it in comparison to GDP growth and real interest rates.

All in all, we find a robust statistical relationship between rapid credit growth at each bank portfolio and problem loans later on. The lag is around four years so, bank managers and short term investors (including shareholders) might have incentives to foster today credit growth in order to rip short term benefits to the expense of long term bank stakeholders, including among the later depositors, the deposit guarantee fund and banking supervisors as well.

The long lag between credit growth and problem loans is very relevant from the prudential point of view since it might fuel disaster myopia, herd behaviour and agency problems between shareholders and bank managers. Bank managers, pressed by their peers, the strong competitive environment, investors focused on quarterly or, at most, year profitability figures, and reassured by the fact that more lax credit standards do not produce, in the short run, more impaired assets, might be strongly encouraged to follow too risky credit policies that, in the medium term, could jeopardise the survival of the bank and, from a systemic point of view, threaten the stability of the whole financial system. Prudential supervisors are well aware of the former developments and, some of them, as we will see in the next section, have recently started to implement appropriate responses.

15. Note that, the relevant test here is to test if $\alpha+\beta$ (and $\alpha-\beta$) is significant, not each of them alone.

2.2 Probability of default and credit growth

The former subsection has shown a positive relationship between aggregate loan growth and aggregate non-performing loan ratios at the level of each bank. Although this result is very important from a prudential point of view, the present section explores a new avenue, to our knowledge unchartered, for the same prudential policies. Instead of focusing on bank-aggregated level credit risk measures, we analyse the probability of default at an individual loan level and its relation to the cyclical position of the bank credit policy. The hypothesis is that, for the reasons explained in section 1 above, those loans granted during credit booms are riskier than those granted when the bank is reining on loan growth. That would provide a rigorous empirical micro foundation for prudential regulatory devises aimed at covering the losses embedded in rapid credit growth policies.

In order to test the former hypothesis we use individual loan data from the Credit Register. We focus on loans granted to non-financial firms with a maturity larger than one year and keep track of them the following years.[16] We study only financial loans (i.e. excluding, receivables, leasing, etc.), which are 60% of the total loans to non-financial firms in the Credit Register, granted by commercial banks and savings banks (95% of market share in loans among credit institutions). Table 3 shows the descriptive statistics for the relevant variables in this model.

The equation estimated is:

$$\Pr(DEFAULT_{ijt+k}=1)=F(\theta+\alpha(LOANG_{it}-averageLOANG_i)+\beta\left|LOANG_{it}-averageLOANG_i\right|$$
$$\chi LOANCHAR_{iit}+\delta_1 DREG_i+\delta_2 DIND_i+\delta_3 BANKCHAR_{it}+\varphi_t+\eta_i) \tag{2}$$

where we model the probability of default of loan *j*, in bank *i*, some *k* years after being granted (i.e. at t+2, t+3, and t+4),[17] as a logistic function [*F(x)=1/(1+exp(-x))*] of the characteristics of that loan (LOANCHAR), such as its size, maturity (i.e. between one and three years and more than three years) and collateral (fully collateralised or no collateral); a set of control variables (i.e. the region, DREG, where the firm operates, the industry, DIND, to which the borrower pertains), characteristics of the bank that grants the loan such as its size and type (i.e. commercial or savings bank). We also control for macroeconomic characteristics including time dummies (φ_t).

We do not consider default immediately after the loan is granted (i.e. in t+1) because it takes time for a bad borrower to reveal as such. When they are granted a loan, take the money from the bank, invest it into the project and, as the project develops, are able to return the loan and the due interest payments or are not, and default.

Once we have controlled for loan, bank and time characteristics, we add the relative loan growth rate of bank *i* at time *t* with respect to financial loans granted to non-financial firms ($LOANG_{it}$-$averageLOANG_i$), that is, the current lending position of each bank in comparison to its average loan growth. If α is positive and significant we interpret this as a

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16. The level and evolution of PD across time and firm size in Spain can be seen in Saurina and Trucharte (2004). On average, large firms (i.e. those with annual sales above € 50 million) have a PD between 4 and 5 times lower than that of small and medium sized enterprises (i.e. firms with annual turnover below € 50 million).

17. We consider that a loan is in default when its doubtful part is larger than the 5% of its total amount. Thus, we exclude from default small arrears, mainly technical, that are sorted out by borrowers in a few days and that, usually, never reach the following month.

signal of more credit risk in boom periods when, probably, credit standards are low. On the contrary, when credit growth slows, banks become much more careful in scrutinising loan applications and, as a result, next year defaults decrease significantly. To our knowledge, this is the first time that such a direct test is run. Additionally, we also test for asymmetries in that relationship, as in the previous section. As in the previous model, we have considered only those banks with a loan growth rate within the 5th and 95th percentile, to eliminate outliers.

It is very important to control for the great heterogeneity due to firm effects, even more because our database does not contain firm related variables (i.e. balance sheet and profit and loss variables). For this reason, we have controlled for firm (loan) characteristics using a random effects model, which allow us to take into account the unobserved heterogeneity (without limiting the sample as the conditional model does) assuming a zero correlation between this firm effects and the rest of the characteristics of the firm.

Table 4 (Panel A) shows the estimation result for the pool of all loans granted. We observe that the faster the growth rate of the bank, the higher the likelihood to default the following years. We observe that α is positive and significant when we consider defaults three and four years later, and positive, although not significant for defaults two years after the loan was granted (Table 4, columns 1, 3, and 5). As mentioned before, although not reported in Table 4, we control for macroeconomic characteristics, region and industry of the borrowing firm, size and type of bank lender and, finally, for size, maturity and collateral of the loan granted.[18]

In terms of the economic impact, the semi-elasticity of the credit growth is 0.13% for default in t+3 (0.13% in t+4),[19] which means that if a bank grows one percentage point above its average, then the likelihood of default in t+3 is increased by 0.13% (0.13% in t+4). Although these figures are relatively small, when we consider one standard deviation above the average rate of growth, the semi-elasticity increases to 1.9% (1.9%).

We have also investigated if there is an asymmetric impact of loan growth over future loan defaults (columns 2, 4, and 6 in Table 4). In good times, when loan growth of each bank is above its average, we find a positive and significant impact on future defaults (two, three and four years later). However, in bad times, with loan growth below the average of the bank, there is no impact on defaults. Thus, this asymmetric effect reinforces the conclusions about too lax lending policies during booms.

To test the robustness of the former results, Panel B in Table 4, shows the estimation of the same model than before when the loan growth rate of the bank is introduced without any comparison to its average value. The results obtained are exactly the same: there is no effect on the probability of default in t+2 and a positive and significant one on the likelihood of default in t+3 and t+4.

All in all, the previous results show that in good times, when credit is growing rapidly, credit risk in bank loan portfolio is also increasing.

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18. The same result is obtained if, instead of AVERAGE LOANG$_i$, we use AVERAGE LOANG$_t$, that is, comparing the individual loan growth rate to the average rate of the whole banking sector across time.

19. The marginal effect of the *k*-variable is computed as: $ME_k = \frac{d\left[\Pr ob(y=1|\bar{x})\right]}{dx_k} = \Lambda(\hat{\beta}\bar{x})\left[1-\Lambda(\hat{\beta}\bar{x})\right]\hat{\beta}_k$.

Then, the semi-elasticity is given by $ME_k \big/ Average \quad Default$.

2.3 Collateral and credit growth

The two former subsections have provided direct tests of the impact of credit growth on credit risk. This subsection provides evidence of the behaviour of banks in terms of their credit policies along the business cycle. The argument so far has been that too rapid credit growth comes with lower credit standards and, later on, manifests in higher problem loans. Here, we provide some complementary evidence based on the tight relationship between credit cycles and business cycles. We argue that depending on the business cycle position, banks adjust their credit policies. For instance, in good times, banks relax credit standards and are prepared to be more lenient in collateral requirements. On the other hand, when the recession arrives banks toughen credit conditions and, in particular, collateral requirements.

If the hypothesis presented in the former paragraph is true, we would have complementary evidence to support prudential regulatory policies. It is not only that during boom times loan portfolios are increasingly loaded with higher expected defaults but also the fact that other protective devises for banks, such as collateral, are eroded.[20]

The following equation allows us to test the relationship between collateral and economic cycle.

$$\Pr(Collateral_{ijklt} = 1) = F(\theta + \alpha GDPG_{t-1} + \beta \left| GDPG_{t-1} - Average \quad GDP \right| + Control \quad Variables_{ijklt}), \tag{3}$$

A full description of model (3) and its control variables is in Jiménez, Salas and Saurina (2005). Here we only focus on the impact of GDP growth on collateral, controlling for the other determinants of collateral. The variable in the left hand side takes the value of 1 if the loan is collateralized and 0 otherwise. *j* refers to the loan, *i* refers to the bank, *k* refers to the market, *l* refers to firm (borrower) and *t* refers to the time period (year). We estimate equation (3) using a probit model. As control variables we use borrower characteristics (i.e. if they were in default the year before or the year after the loan was granted, its indebtedness level and age as borrower), bank characteristics (size, type of bank, and its specialization in lending to firms), characteristics of the borrower-lender relationship (duration and scope) as well as other control variables (such as the level of competition in the loan market, the size of the loan, the industry and the region of the borrower).[21]

The database used is, as in section 2.2, the Credit Register. We focus on all new financial loans above € 6,000 with a maturity of one year or more, granted by any Spanish commercial or savings bank to legal persons (i.e. business) every year during the time-period between December 1984 and December 2002. We exclude commercial loans, leasing, factoring operations and off-balance sheet commitments for homogeneity reasons. In this sample, the 33.6% of all loans are collateralized. By maturity, there is more heterogeneity: 54.4% of the loans with maturity larger than 3 years are collateralized, while only 8.5% of the rest of loans are secured.

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20. It might also be the case that banks during good times decrease credit risk spreads in their granted loans partially as a result of over optimism and tight competition among banks. The opposite would happen in bad times when bank managers would tighten credit spreads. Unfortunately, our database does not allow to test this hypothesis.

21. Jiménez, Salas and Saurina (2005) contain a similar analysis on a different sample of loans and using a different estimation procedure (i.e. fixed effects).

The first column in Table 5 shows the results of estimating model (3) for the pool of loans, nearly 2 million loans. There is a negative and significant relationship between GDP growth rates and collateral; that is, in good times banks lower collateral requirements just to increase them in bad times. In terms of the impact, the semi-elasticity of GDPG is -3.1%, which means that an increase of one percentage point in the GDPG reduces the likelihood of collateral by 3.1%. In the bond market, Altman et al. (2002) find evidence of a positive and significant correlation between the probability of default (PD) and the loss given default (LGD). Our results, focusing on the loan market, show that the positive correlation between PD and LGD need not to hold since banks, as the recession approaches (the PD increases), take more collateral on their loans which might decrease the LGD.[22]

The cyclical behaviour of banks regarding collateral is not symmetric. Column 2 in Table 5 shows an asymmetric impact: the likelihood to pledge collateral decreases proportionally more in upturns that increases in downturns, as the negative and significant value of the parameter of the absolute value of the difference between GDP rate of growth and its average across the period studied points out (i.e. -0.092 in upturn *versus* -0058 in downturns). Despite the asymmetry, the negative relationship between loan PD and LGD still might hold. Moreover, from a prudential point of view, there are even more concerns regarding the too lax credit policies maintained by banks during upturns.[23]

Credit markets are segmented across borrowers and across maturities. So, it might be possible that the former aggregated results do not hold for particular market segments. To carry out this robustness exercise, the database is split into two groups: short-term (maturing at one to three years) and long-term (more than three years). A second classification of the loans relates to the experience of the borrower. One group of loans, labelled “old”, contains those loans from borrowers about whom, at the time the loan is granted, there is already past information in the database (for instance, if they were in default the previous year). The other group of loans, which we call “new”, is from borrowers obtaining a loan for the first time.

Table 5 (columns 3 to 6) shows that although there are some differences across the maturity of borrowers and across old and new borrowers, the main results hold. For old borrowers, the impact of the business cycle on collateral policy is larger for long term loans than for short term ones. We find the same result across new borrowers but the magnitude of the decline in collateral as the economy improves is lower. For short term loans, both old and borrowers, during upturns collateral requirements decline while in downturns they do not increase, either because the firm has no collateral to pledge or because banks put in place other strategies to recover their short term loans.[24]

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22. We thank M. Gordy for pointing us this implication.

23. The same estimation has been carried out replacing GDP growth by the loan growth of the banking sector and the results are quite similar.

24. Again, the same results are obtained if we substitute GDP growth by the loan growth of the banking sector, as in the previous footnote.

3 A new prudential tool

The former section has shown clear evidence of a relationship between rapid credit growth and a deterioration in credit standards that, eventually leads to a significant increase in credit losses. Banking regulators, aware of this behaviour and concerned about long-term solvency on individual banks as well as the stability of the whole banking system, might wish to implement some devises in order to alleviate the market imperfection.

Borio et al. (2001) contain a detailed discussion of procyclicality and banking regulator responses. There has been a lot of discussion around the impact of Basel II on the cyclical behaviour of new capital requirements.[25] Here, we want to focus on loan loss provisions since we think that they are the proper instrument to deal with expected losses. Thus, we propose a new prudential provision that addresses the fact that credit risk builds up during credit boom periods. That new provision is on top of the already existing specific (for incurred and already identified losses in individual loans) and general provision (for incurred and not yet individually identified losses). The latter one can be interpreted as a provision for the inherent or latent risk in the portfolio, that is, an average provision across the cycle. The new loan loss provision (or the third component of the total loan loss provision) is based on the credit cycle position of the bank in such a way that the higher the credit growth of the individual bank the more it has to provision. On the contrary the lower the credit growth the more provisions can liberate from the previously built reserve. Analytically, we can write:

$$LLP_{total} = specif. + g\Delta C + \alpha(\Delta C - \gamma C_{t-1}) \qquad (4)$$

where the total loan loss provision (LLP_{total}) has three components: the specific provision (specif.), the latent provision (applied on each new loan granted to cover the average credit risk, g) and, finally, the third component (cyclical) where C_{t-1} is the stock of loans the previous period, γ is the average loan growth rate across banks and across a lending cycle, and ΔC is the absolute growth in total loans. Thus, when the loan portfolio grows above the average historical growth, the provision is positive and negative otherwise.

Note that in boom periods the loan provision is positive and negative during recessions and the more far away the bank behaviour from the total system the larger the provisioning impact. The underlying idea is quite simple, the more rapid credit growth, the higher the increase in market share and, presumably following our empirical results, the higher the credit risk is assuming the bank and, therefore, the higher the loan loss provision. The asymmetry found in some of the results of the former section Table 2 points towards an increase in loan loss provisions in good times, when credit risk increases and there is rapid credit growth, and allowing the previously built loan loss reserves being depleted in downturns, when the former rapid credit growth materialises in loan losses.

The former proposal is a very simple and intuitive prudential tool to cope with credit risk linked to cyclical lending policies. That provision is not expected to replace the existing provisions but rather to reinforce them. Then, we would have specific provisions for impaired assets already individually identified plus provisions to cover inherent losses in homogeneous groups of loans (i.e. losses incurred but not yet identified in individual loans).

25. The issue of procyclicality of capital requirements has risen a lot of attention [Daníelsson et al. (2001), Borio et al. (2001) and, more recently, Kashyap and Stein (2003) and Gordy and Howells (2004), to name a few].

The third component of LLP_{total}, the cyclical one, has been considered in our proposal as an additional loan loss provision. Alternatively, it could count, for instance, as part of capital requirements (for instance, asked through Pilar 2 of the Basel II framework). Banking supervisors, according to their experiences regarding lending cycles and credit risk, might ask banks to hold higher capital levels during booms in order to take into account future problem loan developments. Note that this proposal might contribute to alleviate potential concerns, if any, about increased capital procyclicality within Basel II framework.

Simulations

Probably, the best way to understand the workings of the loan loss provision put forward in this section, which we call stress provision, is through a simulation exercise. Table 6 contains such an exercise. We simulate a full economic and lending cycle in eleven years. The first two years the economy is expanding at full steam which means rapid credit growth and very low specific loan loss provisions (as a result of low problem loan ratios). From year 3 onwards credit growth decreases and problem loans increase with a subsequent increase in specific provisioning requirements. In year 6 the trough is reached with a maximum in provisioning requirements and a minimum in lending growth. From year 7 onwards the credit and the economy recover and specific provisions decline.

The mechanism of the stress provision is straightforward. While loan growth rates are above the average loan growth rate (i.e. γ=10.1%) the stress provision is positive and the amount charged in the P&L is accrued in a stress fund. When loan growth is starting to be below the average the stress provision is negative and it is accrued in the P&L from the stress fund previously built. After year 9 the stress provision resumes a positive value (as a result of a new expansionary credit cycle) and the stress fund is being built again.

Which is the final impact of the new provision over a framework which already has a specific and an inherent risk provision? The total loan loss provision is smoother than the sum of the specific and the inherent provisions (Chart 1). But the smoothing is far from total. There is still quite significant variation across the credit cycle of total loan loss provisions. Of course, during recessions provisions reach the maximum amount, as the specific one dominates the landscape. However, in truly boom periods (i.e. year 1 and 2) when loan growth is extremely high as a result, quite probably, of less prudent lending policies, provisioning requirements through the stress provision are significant. Note that the new provision is also countercyclical but given its mechanism is not able to have a significant impact on total loan loss provisions unless the variability in credit growth rates is extreme which, for most of the banks is not the case. At the same time, the volatility of profits is somewhat lower through the cycle. Note that the stress provision is quite transparent and analysts could undo its impact on the P&L or even the regulatory capital of the bank.

The former simulation exercise has used a previously built fund (i.e. the general or inherent fund currently accumulated) as the starting point of the simulation (15, or 1.5% of the outstanding loan portfolio in year 0 of the simulation). However, it could be possible to start the new fund from scratch. The only drawback of that approach would be that, depending on the evolution of the credit cycle, it might be possible that the fund was exhausted earlier and that some years would remain at zero.[26]

26. Of course, it is understood that the fund can not be negative, that is, to write as income in the profit and loss statement something that has not been previously built up.

4 Policy discussion

We show clearly in the paper the lagged relationship between credit growth and problem loans. We provide evidence of the relationship between loan growth today and future losses. Therefore, from a prudential point of view there is a rationale for setting aside provisions since the loan is granted, that is to say, since the credit risk enters the balance sheet of the bank.[27] Moreover, the empirical results provide a rationale for countercyclical loan loss provisions, apart from those covering impaired assets or the latent risk in the loan portfolio. However, accounting frameworks do not fully recognise and, thus, allow for coverage, of the economic findings around credit policies.

From January 2005, all European Union firms (either banks or non-financial firms) with quoted securities in any EU organised market will have to comply with International Financial Reporting Standards (IFRS or IAS). That means a change in the current provisioning system based on specific and general provisions. From 2005 onwards, banks will have to set aside provisions to cover individually identified impaired assets and, for homogeneous loan portfolios, they will be required to cover losses incurred but not yet identified in individual loans.

IAS 39 does not allow to set aside provisions for future losses when a loan is granted. Moreover, the new or prudential provision developed in this paper is, probably, even less in line with IAS. Therefore, the new IAS do not perfectly match the prudential concerns of banking regulators. Borio and Tsatsaronis (2004) show a way forward to sort out this problem through a decoupling of objectives (i.e. one is to provide unbiased information and the other is to instilling a degree of prudence). To us a more fundamental question is the purpose that the accounting framework should serve to and, more importantly, at what price. Financial stability concerns and, therefore, prudent accounting, should probably be more up into the list of priorities, in particular, since there is overwhelming evidence of earnings management. The incentives to alter the accounting numbers will not disappear with IAS.[28] If investors will not, in any case and with a high probability, get the unbiased figures, there might be room for instilling prudent behaviour through the accounting rules.

Alternatively, if accounting principles are written in a way that do not allow for sheltering prudential concerns, banking regulators might try other devises in order to counterbalance the negative impact of excessive decreases in credit standards during boom periods. For instance, Pillar 2 of the new framework put forward by supervisors in Basel II might include a stress of capital requirements that might be based along the lines developed here for the new provision. In a sense, if the accounting framework does not provide enough flexibility to banking supervisors, they should find it through the allowed supervisory discretion of Pillar 2.

Either as an additional loan loss provision or as a capital requirement, the third component of total loan loss provisions will help to counter the cyclical behaviour of own funds in Basel II. Basel I was not properly tracking banks' risks. Basel II is meant to have

27. As for an insurance company, the risk, and the technical provision to cover it, appear just after the insurance policy has been sold to the customer.

28. For a theoretical rationale of income smoothing see, among others, Fudemberg and Tirole (1995) and Goel and Thakor (2003).

capital requirements more closely tied to risk. Capital requirements will increase during recessions as the probability of default increases. However, the evidence provided in this paper argues, together with the theoretical papers referenced, that (ex ante) credit risk increases during boom periods. Therefore, without interfering with Basel II Pillar 1 capital requirements, Pillar 2 adjustment might help to take into account those increases in ex ante credit risk and, somehow, soften the procyclicality of capital requirements.[29]

Rajan (1994) discusses possible regulatory interventions in order to reduce the expansionary bias in lending policies. Among them, to decrease the amount of loanable funds or to impose credit controls. However, both proposals do not seem very feasible since they might have other negative unintended consequences, as the author recognises. Alternatively, a close monitoring of bank portfolios by supervisors, and the corresponding penalties, might be the answer. However, that will increase the cost of supervision substantially. In our paper we provide a simple mechanism to cope with the negative consequences of herd behaviour and managers short-term horizons that is cheaply monitored and easily available for bank supervisors. Moreover, the prudential provision presented in the former section is not designed to curtail credit growth but to account for the negative impact of too liberal lending policies. It is up to each bank manager to decide its lending policy but if the lending policy is reckless, loan loss provisions will be proportionally higher since the inception of the lending policy just to account for future higher credit losses.

The paper also has some implications in terms of financial information disclosure and transparency. It is argued that more disclosure of information by banks will help investors to discipline bank managers and, therefore, to help banking supervisors as well. In fact that is the main rationale for Pillar 3 of Basel II. However, some recent research [Morris and Shin (2002)] points towards a more nuanced position regarding the welfare achievements of more transparency and disclosure and the above mentioned widespread existence of earnings management. In fact, Rajan (1994) finds what he calls a counterintuitive comparative statics: "allowing banks to fudge their accounting numbers and to maintain secret reserves (sic) can improve the quality of their lending decisions".

As it has been previously mentioned, the new provision is fully transparent. Investors and, more generally, any bank stakeholder could "undo" the effects of the stress provision since it only needs to look at the lending growth rate of the bank and the average of the system. Of course, transparency could improve even more if regulators make compulsory to release the amount of the stress provision in the Annual Report of each bank. The issue here is that we are not trying to manage earnings or, more precisely, to smooth banks' income through that provision. Instead, we are just trying to cope with latent risks in bank loan portfolios not properly address by IAS or even Basel II capital requirements in such a way that is fully transparent. Maybe as another prove of counterintuitive reasoning, it might be possible that our proposal could contribute to a decline in income smoothing practices across banks since, partially at least, some of their causes would be covered by the new provision. Thus, contrary to Rajan, banking regulators would have no need for allowing banks more discretion to fudge their accounts since, precisely, the regulatory framework would allow for an appropriate coverage of latent risks in good times and a lower impact on the P&L in bad periods that results in a less volatile pattern for profits through the cycle.

29. The LLP we propose here might work as the "second instrument" proposed by Goodhart (2005) to maintain financial stability.

Banco de España has applied the so-called statistical provision from mid-July 2000 onwards. As it has been mentioned, it is a countercyclical provision. When the three currently existing loan loss provisions (i.e. specific, general and statistical) are added up through and economic cycle, the quotient between total loan loss provisions and total loans remains almost constant along time. Accountants did not ever liked this total smoothing effect along the credit cycle. The new provision that we have developed in the former Section does not have those drawbacks. First of all, the quotient between total loan loss provisions and total loans shows a cyclical pattern (i.e. increases in bad times) but much less pronounced than before. Therefore, expected losses are not constant along the entire business cycle. From a prudential point of view, it is very important that total loan loss provisions are relatively high in the peak of the lending boom. Secondly, although total loan loss provisions are high in boom periods, the maximum is reached around the recession, when impaired assets are also at their maximum. Thus, loan loss provisions are not completely smooth out along the business cycle.

5 Conclusions

Disaster myopia, herd behaviour, agency problems and fading recollections of past bad experiences, coupled with increasing banking competition may bring about lower credit standards while screening potential borrowers that translate into too expansionary credit policies and, eventually, on higher loan losses. Rajan (1994) demonstrates that banks' managers can end up, collectively, financing negative net present value projects. That behaviour is the rational response to the short term objectives that face those managers. Therefore, a bank regulator concerned about the negative effects of too rapid credit growth on individual banks solvency and on the whole stability of the banking system might use some prudential tools in order to curtail excessive lending during boom periods and, by the same token although in the opposite direction, too conservative credit policies during recessions.

The empirical literature on the relationship between excessive loan growth and credit risk is scant. The first contribution of this paper is to provide more precise and robust evidence of a positive, although quite lagged, relationship between rapid credit growth and future non-performing loans of banks. Moreover, we also find a direct relation between the phase of the lending cycle and the quality and the standards of the loans granted. During lending booms, riskier borrowers obtain funds and collateral requirements are significantly decreased. Lower credit standards and a substantial lag between decisions made on loan portfolios and the final appearance of loan losses point towards credit risk significantly increasing during good times. Therefore, credit risk increases in boom periods although it only pops up as loan losses during bad times.

The second contribution of the paper is to develop a loan loss provision (i.e. a prudential tool) that takes into account the former developments. The idea is that banks should provision during good times for the increasing risk that is entering in their portfolios and that will only reveal as such with a lag. On the other hand, in bad times banks could use the reserves acumulated during boom periods in order to cover the loan losses that appear but that entered the portfolio in the past. Thus, we develop a countercyclical provision that is a direct answer to the robust empirical finding of credit risk increasing in good times.

Accounting frameworks usually do not allow for countercyclical provisioning, that is, for the coverage today of latent credit risk in banks' portfolios. Therefore, given the interest of supervisors in a prudent coverage of risks, it might be possible to transform the former countercyclical provision into a capital requirement based on an stress test included in Pillar 2 of Basel II, the new regulatory capital framework for banks. In doing that, those that have shown concerns about increased procyclicality of Basel II might find some help.

All in all, the paper combines theoretical arguments with robust empirical findings to provide the rationale for a countercyclical loan loss provision. The paper is a contribution to the intense debate among supervisors and academics on the proper tools to enhance financial stability.

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Table 1. Descriptive statistics

NPL_{it} is the non-performing loan ratio, that is, the quotient between non-performing loans and total loans. $GDPG_t$ is the real rate of growth of gross domestic product. RIR_t is the real interest rate, calculated as the interbank interst rate less the inflation of the period. $LOANG_{it}$ is the rate of the growth of loans for bank *i*. $HERFR_{it}$ is the Herfindahl index of bank *i* in terms of the amount lent to each region. $HERFI_{it}$ is the Herfindahl index of bank *i* in terms of the amount lent to each industry. $COLIND_{it}$ is the percentage of fully collateralized loans to households over total loans for bank *i*. $COLFIR_{it}$ is the percentage of fully collateralized loans to firms over total loans for bank *i*. $SIZE_{it}$ is the market share of bank *i*. All variables in percentage points. *i* is for bank and *t* for year.

Variable	Mean	St. Dev.	Min	Max
NPL_{it}	3.94	5.70	0.00	99.90
$GDPG_t$	2.90	1.51	-1.03	4.83
RIR_t	4.14	2.90	-0.67	8.12
$LOANG_{i,t-2}$	17.36	14.37	-17.29	71.97
$LOANG_{i,t-3}$	17.37	13.93	-13.80	67.82
$LOANG_{i,t-4}$	17.54	14.09	-11.10	64.68
$HERFR_{it}$	52.68	24.86	11.26	98.87
$HERFI_{it}$	18.47	9.82	7.45	70.26
$COLIND_{it}$	19.25	16.28	0.00	69.91
$COLFIR_{it}$	20.47	12.89	0.00	70.35
$SIZE_{it}$	0.59	1.05	0.00	8.79

Table 2. GMM estimation results of equation:

$$\log\left[NPL_{it}/(100-NPL_{it})\right] = \alpha\log\left[NPL_{it-1}/(100-NPL_{it-1})\right] + \beta_1 GDPG_t + \beta_2 GDPG_{t-1} + \beta_3 RIR_t + \beta_4 RIR_{t-1} + \delta_1 LOANG_{it-2}$$
$$+\delta_2 LOANG_{it-3} + \delta_4 LOANG_{it-4} + \chi_1 HERFR_{it} + \chi_2 HERFI_{it} + \varphi_1 COLIND_{it} + \varphi_2 COLFIR_{it} + \omega SIZE_{it} + \eta_i + \varepsilon_{it}$$

In this regression the dependant variable, the non-performing loan ratio (NPL_{it}), has been replaced by its logistic transformation to obtain a non bounded dependant variable: *Log[*NPL_{it} */(100-*NPL_{it}*)]*. The lagged dependent variable is introduced as an explanatory variable to account for persistence effects over time. $GDPG_t$ is the real rate of growth of gross domestic product. RIR_t is the real interest rate, calculated as the interbank interst rate less the inflation of the period. $LOANG_{it}$ is the rate of the growth of loans for bank *i*. $HERFR_{it}$ is the Herfindahl index of bank *i* in terms of the amount lent to each region. $HERFI_{it}$ is the Herfindahl index of bank *i* in terms of the amount lent to each industry. $COLIND_{it}$ is the percentage of fully collateralized loans to households over total loans for bank *i*. $COLFIR_{it}$ is the percentage of fully collateralized loans to firms over total loans for bank *i*. $SIZE_{it}$ is the market share of bank *i*. η_i control for unobserved bank fixed effects. $HERFR_{it}$, $HERFI_{it}$, $COLFIR_{it}$, $COLIND_{it}$ are treated as endogenous using lags t-2 and t-3. NPL_{it-1} is predetermined and 3 lags have been used as instruments (i.e. NPL_{it-2}, NPL_{it-3} and NPL_{it-4}). Robust SE reported.

	Model 1		Model 2		Model 3		Model 4	
Variables	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
$NPL_{i,t-1}$	0.5524	0.0887 ***	0.5520	0.0889 ***	0.5499	0.0841 ***	0.5447	0.0833 ***
Macroeconomic characteristics								
$GDPG_t$	-0.0631	0.0135 ***	-0.0654	0.0137 ***	-0.0709	0.0131 ***	-0.0716	0.0134 ***
$GDPG_{t-1}$	-0.0771	0.0217 ***	-0.0770	0.0220 ***	-0.0750	0.0212 ***	-0.0777	0.0209 ***
RIR_t	0.0710	0.0194 ***	0.0703	0.0193 ***	0.0704	0.0195 ***	0.0711	0.0192 ***
RIR_{t-1}	0.0295	0.0103 ***	0.0292	0.0103 ***	0.0262	0.0098 ***	0.0263	0.0101 ***
Bank characteristics								
$LOANG_{i,t-2}$	-0.0008	0.0013	-0.0008	0.0013				
$LOANG_{i,t-3}$	0.0018	0.0012	0.0018	0.0012				
$LOANG_{i,t-4}$ (α)	0.0034	0.0012 ***	0.0029	0.0012 **				
$\lvert LOANG_{i,t-2}$ - AVERAGE $LOANG_i\rvert$			0.0004	0.0017				
$\lvert LOANG_{i,t-3}$ - AVERAGE $LOANG_i\rvert$			-0.0005	0.0016				
$\lvert LOANG_{i,t-4}$ - AVERAGE $LOANG_i\rvert$ (β)			0.0025	0.0019				
$LOANG_{i,t-2}$ - AVERAGE $LOANG_t$					0.0007	0.0012	0.0011	0.0013
$LOANG_{i,t-3}$ - AVERAGE $LOANG_t$					0.0015	0.0013	0.0014	0.0014
$LOANG_{i,t-4}$ - AVERAGE $LOANG_t$ (α)					0.0025	0.0013 **	0.0020	0.0013
$\lvert LOANG_{i,t-2}$ - AVERAGE $LOANG_t\rvert$							-0.0026	0.0018
$\lvert LOANG_{i,t-3}$ - AVERAGE $LOANG_t\rvert$							0.0017	0.0017
$\lvert LOANG_{i,t-4}$ - AVERAGE $LOANG_t\rvert$ (β)							0.0029	0.0018
$HERFR_{it}$	0.0212	0.0096 **	0.0209	0.0097 **	0.0207	0.0098 **	0.0218	0.0099 **
$HERFI_{it}$	-0.0032	0.0094	-0.0025	0.0095	-0.0038	0.0098	-0.0026	0.0097
$COLFIR_{it}$	0.0034	0.0063	0.0034	0.0063	0.0034	0.0065	0.0046	0.0065
$COLIND_{it}$	-0.0125	0.0072 *	-0.0125	0.0072 *	-0.0141	0.0073 *	-0.0141	0.0074 *
$SIZE_{it}$	0.0199	0.0482	0.0153	0.0486	0.0213	0.0475	0.0261	0.0484
Time dummies	no		no		no		no	
No. Observations	868		868		868		868	
Time period	1984-2002		1984-2002		1984-2002		1984-2002	
Sargan test [$\chi(2)_{138}$] / p-value	124.76	0.78	125.56	0.77	123.85	0.80	122.86	0.82
Firts order autocorrelation (m_1)	-5.43		-5.37		-5.36		-5.28	
Second order autocorrelation (m_2)	-1.27		-1.4		-1.34		-1.24	
Test asymmetric impact (p-value)								
$\alpha+\beta=0$	--		0.01		--		0.01	
$\alpha-\beta=0$	--		0.84		--		0.73	

Table 3. Descriptive statistics

DEFAULT is a dummy variable that takes 1 if the loan is doubtful, and 0 otherwise. $LOANG_{it}$ is the growth rate of all financial credits granted to firms by bank *i.*

Variable	Mean	St. Dev.	Min	Max
$DEFAULT_{ijt+2}$ (0/1)	0.008	0.09	0.00	1.00
$DEFAULT_{ijt+3}$ (0/1)	0.004	0.07	0.00	1.00
$DEFAULT_{ijt+4}$ (0/1)	0.002	0.05	0.00	1.00
$LOANG_{i,t}$	20.08	19.64	-40.10	115.15
Maturity 1y-3y (0/1)	0.47	0.50	0.00	1.00
Maturity 3y-5y (0/1)	0.20	0.40	0.00	1.00
Maturity >5y (0/1)	0.33	0.47	0.00	1.00

Table 4. Estimation results of the equation:

$$\Pr(DEFAULT_{ijt+k}=1)=F\left[\theta+\alpha\left(LOANG_{it}-Average\ \ LOANG_{i}\right)+\beta\left|LOANG_{it}-Average\ \ LOANG_{i}\right|+Control\ \ variables_{ijt}+\varphi_{t}+\eta_{i}\right],$$

using a random effect logit model. *DEFAULT* is a dummy variable that takes 1 if the loan is doubtful, and 0 otherwise. $LOANG_{it}$ is the growth rate of all financial credits granted to firms by bank *i.* We also control for size and type (i.e. commercial or savings) of the bank and for characteristics of the loan (i.e. size, maturity and collateral). Region, industry, and time dummies have been included.

PANEL A

Variables	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
Dependant variable	$DEFAULT_{ijt+2}$ (0/1)		$DEFAULT_{ijt+2}$ (0/1)		$DEFAULT_{ijt+3}$ (0/1)		$DEFAULT_{ijt+3}$ (0/1)		$DEFAULT_{ijt+4}$ (0/1)		$DEFAULT_{ijt+4}$ (0/1)	
Bank characteristics												
$LOANG_{it}$ - AVERAGE $LOANG_i$ (α)	0.001	0.001	-0.001	0.001 *	0.002	0.001 ***	0.001	0.001	0.002	0.001 **	0.002	0.002
$\|LOANG_{it}$ - AVERAGE $LOANG_i\|$ (β)	--	--	0.005	0.001 ***	--	--	0.001	0.001	--	--	0.000	0.002
Province dummies	yes		yes		yes		yes		yes		yes	
Industry dummies	yes		yes		yes		yes		yes		yes	
No. Observations	1,823,656		1,823,656		1,643,708		1,643,708		1,433,074		1,433,074	
Time period	1985-2004		1985-2004		1985-2004		1985-2004		1985-2004		1985-2004	
Wald test [$\chi(2)$] / p-value	8,959	0.00	9,121	0.00	4,800	0.00	4,874	0.00	2,992	0.00	3,054	
Test asymmetric impact (p-value)												
$\alpha+\beta=0$	--		0.00		--		0.00		--		0.04	
$\alpha-\beta=0$	--		0.00		--		0.93		--		0.55	

PANEL B

Variables	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
Dependant variable	$DEFAULT_{ijt+2}$ (0/1)		$DEFAULT_{ijt+3}$ (0/1)		$DEFAULT_{ijt+4}$ (0/1)	
Bank characteristics						
$LOANG_{it}$	0.001	0.001	0.002	0.001 ***	0.002	0.001 ***
Province dummies	yes		yes		yes	
Industry dummies	yes		yes		yes	
No. Observations	1,823,656		1,643,708		1,433,074	
Time period	1985-2004		1985-2004		1985-2004	
Wald test [$\chi(2)$] / p-value	8,966	0.00	4,802	0.00	2,987	0.00

Table 5. Estimation results of the equation:

$$\Pr(Collateral_{ijklt} = 1) = F(\theta + \alpha GDPG_{t-1} + \beta \left| GDPG_{t-1} - averageGDPG_{t-1} \right| + Control \quad Variables_{ijklt})$$

using a probit model. *COLLATERAL* is a dummy variable that takes 1 if the loan granted to a firm is collateralised, and 0 otherwise. *GDPG* is the real growth rate of gross domestic product. We also control for size, type (i.e. commercial, savings) and lending specialization of the bank, for borrower characteristics (i.e. if they were in default the year before or the year after the loan was granted, its indebtedness level and age as borrower), for characteristics of the borrower-lender relationship (duration and scope) as well as for the level of competition in the loan market, the size of the loan, the industry and the region of the borrower.

	All Borrowers				Old Borrowers				New Borrowers			
	All terms				Long term		Short term		Long term		Short term	
Variable	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
Dependent Variable												
$COLLATERAL_t$ (1/0)												
Macroeconomic characteristics												
$GDPG_{t-1}$ (α)	-0.045	0.001 ***	-0.047	0.001 ***	-0.067	0.001 ***	-0.021	0.002 ***	-0.054	0.002 ***	-0.019	0.004 ***
$\lvert GDPG_{t-1}$ - Average $GDPG_{t-1}\rvert$ (β)	--	--	-0.011	0.002 ***	-0.004	0.002 **	-0.026	0.004 ***	0.002	0.004	-0.027	0.007 ***
Regional dummies	yes		yes		yes		yes		yes		yes	
Industry dummies	yes		yes		yes		yes		yes		yes	
No. Observations	1,972,336		1,972,336		823,340		723,924		254,755		170,317	
Time period	1985-2002		1985-2002		1985-2002		1985-2002		1985-2002		1985-2002	
χ^2 covariates / p-value	279,056	0.00	279,007	0.00	147,630	0.00	39,368	0.00	41,708	0.00	13,668	0.00
Test asymmetric impact (p-value)												
$\alpha+\beta=0$	--		0.00		0.00		0.00		0.00		0.00	
$\alpha-\beta=0$	--		0.00		0.00		0.14		0.00		0.26	

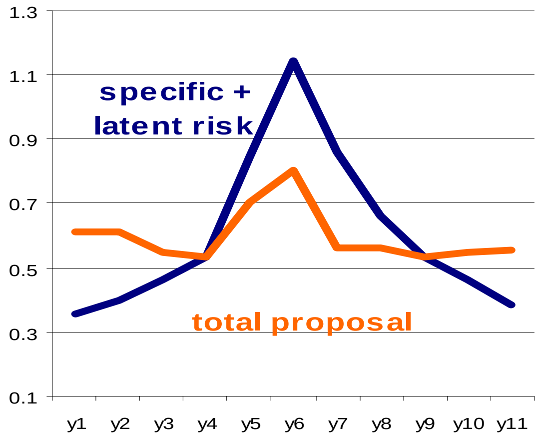
Table 6. Simulation of the new general loan loss provision (specific+latent+cyclical)

	ITEMS	y0	y1	y2	y3	y4	y5	y6	y7	y8	y9	y10	y11	means
	1. Total loans													
a)	Outstanding stock	*1,000*	1,160	1,334	1,494	1,643	1,759	1,811	1,884	2,034	2,238	2,506	2,857	
b)	Rate of growth (%)		*16.0*	*15.0*	*12.0*	*10.0*	*7.0*	*3.0*	*4.0*	*8.0*	*10.0*	*12.0*	*14.0*	10.1 (γ)
c)	Credit cycle position		5.9	4.9	1.9	-0.1	-3.1	-7.1	-6.1	-2.1	-0.1	1.9	3.9	
	2. Profits before provisions													
d)	Level	*21.5*	23.2	25.1	26.1	26.6	26.6	26.1	26.6	27.7	29.3	31.7	34.8	
e)	Rate of growth		*8.0*	*8.0*	*4.0*	*2.0*	*0.0*	*-2.0*	*2.0*	*4.0*	*6.0*	*8.0*	*10.0*	
	3. Net loan loss provision													
f)	Specific		1.7	2.7	4.5	6.6	13.2	19.9	15.1	11.2	9.0	7.5	5.7	
g)	General (latent)	*0.015*	2.4	2.6	2.4	2.2	1.7	0.8	1.1	2.3	3.1	4.0	5.3	
h)	Total		4.1	5.3	6.9	8.8	14.9	20.7	16.2	13.4	12.0	11.5	11.0	
	4. Cyclical provision													
i)	α	*0.050*												
j)	Cyclical provision		3.0	2.8	1.3	-0.1	-2.5	-6.2	-5.5	-2.0	-0.1	2.1	4.9	
k)	Cyclical fund	*15.0*	18.0	20.8	22.1	22.0	19.5	13.2	7.7	5.7	5.7	7.8	12.7	
	5. Total loan loss provisions		7.1	8.1	8.2	8.7	12.4	14.5	10.6	11.5	11.9	13.7	15.9	
	6. Profits after provisions													
l)	Without Cyclical provision		19.1	19.8	19.2	17.8	11.7	5.4	10.4	14.2	17.3	20.1	23.8	16.3
m)	With Cyclical provision		16.1	17.0	17.9	17.9	14.2	11.6	16.0	16.2	17.4	18.0	18.9	16.5
	7. % OVER TOTAL LOANS													
n)	Net loan loss provision		0.36	0.40	0.46	0.54	0.85	1.14	0.86	0.66	0.54	0.46	0.38	0.60
o)	Specific		*0.15*	*0.20*	*0.30*	*0.40*	*0.75*	*1.10*	*0.80*	*0.55*	*0.40*	*0.30*	*0.20*	0.47
p)	General		0.21	0.20	0.16	0.14	0.10	0.04	0.06	0.11	0.14	0.16	0.18	0.14
q)	Cyclical provision		0.25	0.21	0.09	0.00	-0.14	-0.34	-0.29	-0.10	0.00	0.09	0.17	-0.01
r)	Cyclical fund	1.50	1.55	1.56	1.48	1.34	1.11	0.73	0.41	0.28	0.25	0.31	0.44	
s)	Total loan loss provisions		0.61	0.61	0.55	0.53	0.70	0.80	0.56	0.56	0.53	0.55	0.56	0.60
	8. Profits after provisions													
t)	Without cyclical provision		1.64	1.48	1.28	1.08	0.66	0.30	0.55	0.70	0.77	0.80	0.83	0.92
u)	With cyclical provision		1.39	1.27	1.20	1.09	0.81	0.64	0.85	0.80	0.78	0.72	0.66	0.93

Note: All italic figures are taken as given.
a) Stock of all loans given the growth rate in b) and an initial value of 1,000 (benchmark).
c) Credit cycle position is computed as b) minus the average growth rate of the loans in the period.
d) Level of the profits before provision given their growth rate in e) and an initial value of 21.5.
f) Specific provision given its weight over total loans o).
g) 0.015*change in outstanding loans.
h) Sum of f) and g).
j) Cyclical provision given by $\alpha(\Delta \text{Outstanding loans}_t - \gamma \text{ Outstanding loans}_{t-1})$.
k) The cyclical fund is the sum of the previous fund plus the cyclical provision of the year.
l) Profits after provisions without the cyclical provision computed as d)-h).
m) Profits after provisions with cyclical provision computed as d)-Total loan loss provision (5).
p) g)/a).
n) o)+p).
q) j)/ a).
r) k)/ a).
s) 5)/ a).
t) l)/ a).
u) m)/a).

Chart 1. Simulation exercise.

Loan loss provisions as a percentage of total loans



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