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Bank's riskiness over the business cycle: A panel analysis on Italian intermediaries

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BANKS' RISKINESS OVER THE BUSINESS CYCLE: A PANEL ANALYSIS ON ITALIAN INTERMEDIARIES

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Abstract

Supervisors and policy makers pay increasing attention to the possible procyclical nature of banks' behaviour. Indeed, to guarantee macro and financial stability, it is important to understand whether, and to what extent, banks are affected by the macroeconomy and second round effects occur. This paper provides a comprehensive investigation of these issues using a large dataset of Italian intermediaries over the period 1985-2002. In particular, estimating both static and dynamic models, it investigates whether loan loss provisions and non-performing loans show a cyclical pattern. The estimated relations may be employed to carry out stress tests to assess the effects of macroeconomic shocks on banks' balance sheets.

JEL Classification: E30, E32, E44, G28

Keywords: procyclicality, loan loss provisions, non-performing loans, business cycle

Contents

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1. Introduction[1]

In recent years the issue of the possible procyclicality of banks' activity has drawn the attention of both academics and policy makers. Indeed, to guarantee macro and financial stability, it is crucial to understand whether, and to what extent, banks are affected by the evolution of the macroeconomic environment and whether second round impacts occur. On the one hand, if the business cycle does influence banks, financial surveillance may need to be strengthened during recessionary phases, when banks are more likely to become fragile. On the other hand, if banks' reaction to macroeconomic shocks exacerbates the effects of the downturn, it is appropriate to establish rules aimed at alleviating the procyclicality of banks' operations.

The stylized facts suggest that at the beginning of an expansionary phase in the economy firms' profits tend to increase, asset prices rise and customers' expectations are optimistic. Expansion of aggregate demand leads to a remarkable, often more than proportional, growth in bank lending and in the economy's indebtedness. During the boom banks may underestimate their risk exposures, relaxing credit standards and reducing provisions for future losses.

After the peak of the cyclical upturn, customers' profitability worsens, borrowers' creditworthiness deteriorates and non-performing assets are revealed, thus causing losses in banks' balance sheets (cyclicality). This may be associated with a fall in asset prices that, in turn, further affects customers' financial wealth and depresses the value of collateral. Moreover, the possible rise of unemployment reduces households' disposable income and their ability to repay their debts. Banks' risk exposure increases, thus requiring larger provisions and higher levels of capital, at the very moment when it is more expensive or simply not available. Intermediaries may react by reducing lending, especially if they have

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thin capital buffers above the minimum capital requirement, thus exacerbating the effects of the economic downturn (procyclicality).

In principle, many banking variables are potentially able to convey signals about the evolution of banks' riskiness over the business cycle; however, loan loss provisions and bad debts have been generally considered the transmission channels of macroeconomic shocks to banks' balance sheets.

Banks make loan loss provisions against profits when they believe that borrowers will default; this is the tool they can use to adjust the (historical) value of loans to reflect their true value. Provisions affect both banks' profitability, since they represent a cost for the intermediary, and capital, since they reduce the book value of assets.

It is common to distinguish between static (specific) and dynamic (general) provisions, where the former are based on current conditions of debtors and are made only when losses are known to occur, while the latter are set against expected losses on non-impaired loans. The principle that justifies dynamic provisions is that when a loan is granted there is already a positive and measurable probability that the bank will incur losses due to the debtor's inability to honour his obligations. If loan loss provisions were forward-looking, the volume of bank capital would be related to the size of the unexpected losses and the procyclical effects of provisioning policies would be limited. Prudent banks might also use loan loss provisions to stabilize their earnings over time by reducing/increasing the flow of provisions when their performance worsens/improves.

In practice, loan loss provisions are often backward-looking, as banks tend to underestimate future losses in periods of economic expansion because of disaster myopia (Guttentag *et al.*, 1986), herding behaviour (Rajan, 1994) or because higher provisions are interpreted by stakeholders as a signal of lower quality portfolios (Ahmed *et al.*, 1996). Banks tend to provision against actual rather than expected losses also because of accounting and fiscal rules that allow specific provisions only against impaired debts and do not permit tax deductibility for general provisions, since they cannot be documented and may be exploited by banks to reduce their fiscal burden.

Sub-standard loans are also considered a good proxy for asset quality and a reliable leading indicator of bank fragility. In fact, there is clear evidence that the proportion of non-performing loans dramatically increases before and during banking crises (Demirguc-Kunt and Detragiache, 1998; Gonzales-Hermosillo, 1999). The stock of outstanding bad debts is, however, a rough measure of credit quality; in fact it can decrease simply because some of the credits are written off. For this reason, the flow of new bad debts, i.e. the amount of loans classified as bad debts for the first time in the reference period, can be considered a more precise indicator of banks' portfolio riskiness.

Much empirical work has tried to verify the correctness of these stylized facts. Such investigations have generally focussed on a single banks' performance indicator, using relatively small datasets; cross-country comparisons are prevalent, while cross-bank investigations (within the same country) are less common.

This paper contributes to this stream of research using a large panel of Italian intermediaries whose data are available for the period 1985-2002. With respect to previous work, the paper attempts to provide a more comprehensive framework, although in a reduced-form modelling context, analyzing the movements of loan loss provisions and new bad debts over the business cycle. Both static fixed-effects and dynamic models are estimated to verify whether banks' riskiness is linked (also) to the general economic climate and to understand the timing of banks' reactions to economic changes. In a macro-prudential perspective, the outcomes may be employed to carry out stress tests that simulate the impact of some macroeconomic shocks on the Italian banking system.

The remainder of the paper is structured as follows. In the next section I review the empirical literature dealing with the procyclicality of banks' behaviour. Sections 3 and 4 are devoted to a description of the data used in the empirical exercise and the econometric methodology. Sections 5 and 6 present the estimated models, their main findings and some robustness checks. Finally, some concluding remarks are provided.

2. A review of the literature

Notwithstanding the lack of an established theoretical framework, there is a huge empirical literature studying the linkages between banking sector performance and the business cycle. The starting point of the analyses of procyclicality is that the models of banks performance that only include financial ratios as explanatory variables cannot take into account systematic problems arising from an adverse evolution of the macroeconomic environment. The general framework is therefore the following:

$$\textit{Bank-specific variable}_{it} = \textit{bank specific}_{it\text{-}j} + \textit{macroeconomic variables}_{it\text{-}j}$$

where the bank data might be either at single bank or banking system level and the regressors either coincident or lagged. The specification can thus be a simple static model (i=1 and j=0), a distributed lag model (i=1 and j>0) or a panel (i>1, either cross-bank or cross-country).

Since credit risk is still the main source of instability for most banks, the dependent variable is very often a measure of loan quality.

For instance, Salas and Saurina (2002) analyze the relationship between bad loans and the economic cycle in Spain over the period 1985-1997. They observe that during economic booms banks tend to expand lending activity to increase their market share; this result is often reached by lending to borrowers of lower credit quality. They report that bad loans increase in recessionary phases and that the contemporary impact is much higher than the delayed impact, concluding that macroeconomic shocks are quickly transmitted to banks' balance sheets.

In the same spirit, focussing on the banking crises of four Nordic countries (Denmark, Norway, Sweden and Finland), Pesola (2001) assesses the usefulness of macroeconomic shocks in explaining two different indicators of bank distress such as the ratio of loan losses to lending and the number of non-financial companies' bankruptcies per capita. According to his results, the high level of both corporate and households' indebtedness, along with a higher than expected increase in the interest rate and GDP growth below forecasts, contributed to the banking crises in Sweden, Norway and Finland.

The analysis performed by Gambera (2000) is quite different in style. He uses bivariate VAR systems and impulse response functions to study how economic development affects US banks' loan quality. With respect to panel estimation, the VAR methodology allows all variables to be endogenously determined and has the advantage of fully capturing the interactions between bank and macro variables. His results suggest that a small number of macroeconomic variables (namely bankruptcy filings, farm income, annual product, housing permits and unemployment) are good predictors of the problem loans ratio.

Other authors focus on the evolution of provisioning policies through the business cycle since loan loss provisions should reflect changes in borrowers' creditworthiness and banks' sentiment concerning the health of the real economy.

Understanding banks' provisioning behaviour is, for instance, the goal of Cavallo and Majnoni (2002) and Laeven and Majnoni (2003). The latter authors analyze large commercial banks' policies in various countries to verify whether intermediaries use provisions to stabilize their income. They find that bankers, on average, smooth their earnings, but they create too little provision in good (macroeconomic) times. In other words, they find a negative relationship between provisions and loan and GDP growth, suggesting that banks provision during and not before recessions, thus magnifying the effects of the negative phase of the business cycle. Similar evidence is provided by the European Central Bank (2001) in its survey of provisioning practices in the EU; the report also points out that there is an almost simultaneous relationship between provisions and non-performing loans; in other words, banks seem to record provisions only when credit risk actually materializes. Regarding the relationship between provisions and profitability, there is no clear evidence of income-smoothing.

Similarly to Laeven and Majnoni, Pain (2003) and Arpa *et al.* (2001) investigate the influence of the business cycle on loan loss provisions of UK and Austrian banks respectively. The first author considers a large set of explanatory variables proxying macroeconomic disturbances, firms and households' indebtedness, financial and real asset price shocks, and documents that provisions exhibit some cyclical dependence. Arpa *et al.* (2001) conclude that provisions increase in periods of falling real GDP growth. They also find evidence that provisions are higher in times of rising bank profitability, supporting the income-smoothing hypothesis.

An attractive view is provided by Bikker and Hu (2002), who estimate an unbalanced panel to evaluate the procyclicality of banks' provisions for a sample of 26 OECD countries between 1979 and 1999. They find that the coefficients of GDP growth and inflation have a negative sign, while that of the unemployment rate is significantly positive. However, in years of higher net interest income the amount of provisions is larger, thus supporting the income-smoothing hypothesis. Therefore, the authors claim that, even if provisions go down in favourable (macroeconomic) times, banks tend to reserve more in good years (i.e. when profits are higher); as a result, banks are less procyclical than would appear just from looking at their dependence on the business cycle.

In a recent paper Valckx (2003) considers the loan loss provisioning policy of EU banks using a sample of 15 European banking systems and a small panel of large EU banks. According to his results loan loss provisions are determined by GDP growth, interest rates and some bank-specific indicators both at sector level and for individual banks. The positive relationship between income margin and provisions suggests that the income-smoothing hypothesis for EU banks applies, thus contradicting the ECB's findings.

Summing up, good economic conditions positively affect the quality of banks' portfolios as measured by some kind of sub-standard loan ratio. Moreover, there is some evidence on the issue of whether intermediaries tend to use loan loss provisions to smooth their income (i.e. they provision more when earnings increase). However, they do not make enough provision in good macroeconomic times (i.e. when GDP and loan growth are high). Therefore, when economic conditions reverse, loan losses start to emerge, provisions rise, profitability decreases and credit supply tends to decrease, thus amplifying the effects of the recession.

3. The data and the sample

The empirical analysis in this paper aims at investigating how Italian banks' riskiness is affected by changes in general economic conditions. Following the existing literature, the analysis focusses on the evolution of loan loss provisions (hereafter, LLP) and new bad debts to test whether they show the expected cyclical pattern.

With reference to the sample I select an unbalanced panel of 207 Italian intermediaries whose accounting ratios are available for at least 5 consecutive years in the period between 1985 and 2002. The sample excludes all the mutual banks (*banche di credito cooperativo*) and, to reduce measurement errors, the outliers.[2] The resulting sample represents around 90 per cent of the Italian banking system's consolidated total assets.[3] Along with this large unbalanced sample I use a smaller panel of 11 large banks whose data are available for the whole period under examination (18 years) to carry out robustness checks.[4]

A summary of the characteristics of the two samples is provided in Table 1.

Accounting ratios for the individual institutions are built up using the supervisory statistics that intermediaries are required to report to the Bank of Italy and the information of the Italian Credit Register; the macroeconomic variables are drawn from the Bank of Italy and ISTAT statistics and from Datastream. In general, the macroeconomic variables and most of the bank-specific indicators are available at a quarterly frequency and over quite a long time span, even though data homogeneity may be an issue for some time series.

Unfortunately, P&L account ratios are only available on a semi-annual basis since 1993; before that date they were annual. Since the focus of the paper is on the evolution of banks' riskiness through the business cycle, the longer time span is preferred to the higher frequency of the observations. Annual data are therefore used.

Tables 2, 3 and 4 summarize the variables I consider in the analysis and provide some descriptive statistics.

The loan loss provision ratio (LLP) and the flow of new bad debt ratio (RISKFL) vary by construction between 0 and 1. Some authors have suggested using the log-odds transformation of such variables to create an unbounded series between minus and plus infinity. Actually, this seems more a philosophical than a practical issue. In fact, as these variables are typically in the range 0-0.1, the correspondent log-odds ratios are very far from varying between plus/minus infinite as well (Table 4).

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[2] I exclude outlier banks by eliminating the observations in which the values of the bank-specific variables (except SIZE) are above and below the last and the first percentile respectively.

[3] During the 1990s the Italian banking system experienced an intense process of mergers and acquisitions. To deal with the impact of these operations on the sample I assumed that they took place at the beginning of the sample period, consolidating the balance-sheet items of the banks involved.

[4] The sample includes banks with total assets equal to at least 20 billion euros; it represents more than 65 per cent of Italian banks' consolidated total assets.

Finally, some concerns may derive from the presence of unit roots in the series considered in the analysis. Im, Pesaran and Shin's (2003) unit root tests for panel data are therefore carried out; results for the two dependent variables are reported in Table 5.[5]

Tests are performed including both a constant and a constant and time trend and considering both the raw and the demeaned data. The t-bar statistics are always significant at any conventional level, thus confirming that the series for loan loss provisions and new bad debts are stationary.

4. The econometric methodology

The analysis in this paper is carried out using a simple estimation strategy. I start with a static (reduced form) regression using the least square dummy variable (LSDV) model, since fixed effects seem *a priori* able to catch the heterogeneity across individuals, without imposing restrictive conditions on the correlation between the regressors and the error term.[6]

I select the starting set of regressors according to results that emerged in previous empirical analyses. In principle, several variables (GDP, investments, consumption, etc.) might be employed as proxies for the phase of the business cycle; however, a preliminary investigation suggested the use of GDP growth as the main indicator of the aggregate economic activity.[7]

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[5] For simplicity I present only the unit root tests for the dependent variables; tests are, however, carried out for all the regressors as well. For the microeconomic explanatory variables, except RISKST, the tests generally do not find significant evidence of the presence of a unit root. Interestingly, the standard Augmented Dickey Fuller tests (ADF) performed on the aggregate time series fail to reject non-stationarity, thus confirming the advantage in terms of power of also exploiting cross-sectional information. Finally, it is worth noting that most of the macroeconomic series, even the first-differenced ones, seem to be non-stationary according to the ADF tests. This result is affected, however, by the low power of the test, especially in small samples and for near unit root processes (Enders, 1995). More powerful tests, such as Kwiatkowski, Phillips, Schmidt and Shin (1992) unit root tests for the null hypothesis of trend stationarity, fail to reject stationarity at the 5 per cent level.

[6] It is beyond the scope of this paper to set up a complete structural model, even though a system of simultaneous equations might be an appealing tool to describe the co-movements of the variables.

[7] Indeed, the inclusion of investment and consumption changes produced some puzzling results. The use of firms' and households' indebtedness, which are frequently found to be important signals of fragility of the real sector, did not significantly improve the performance of the model and dramatically reduced the sample span, since homogeneous figures for these variables are available since 1990. Moreover, there is no clear-cut evidence on the expected effects of these variables (Salas and Saurina, 2002; Pain, 2003).

Along with GDP growth I also include other macroeconomic indicators – interest rates and the evolution of the stock exchange – that are not intended as business cycle indicators, but try to proxy the competitive conditions in credit markets, debt burden for households and firms, and borrowers' financial wealth. Therefore, they should provide additional information regarding the impact of the macroeconomic environment on banks' operations.

The lag structure of the explanatory variables takes into account the plausible delay with which macroeconomic shocks affect banks, the frequency of the observations and the need to start from a quite general model without losing excessive degrees of freedom. Therefore, as a general rule, the explanatory variables enter the regressions with the current value and one lag; GDP growth enters with 2 lags since its impact on banks is frequently found to be long-lasting in the empirical analyses. As a consequence of the insertion of lagged variables, the period under examination is 1987-2002. At this stage, all the explanatory variables are assumed to be exogenous.

The most parsimonious specification is subsequently chosen through the general-to-simple approach, dropping the less significant variable at each stage and ending up with a set of regressors significant at the 5 per cent level. A preliminary diagnostic revealed the presence of both groupwise heteroskedasticity and first order autocorrelation. I consequently use the Newey-West robust standard errors to carry out inference.

As robustness checks, the most parsimonious representations are re-estimated using the pooled regression and the random effect model.

Although the static model is the natural starting point for analyzing the relationship between economic activity and banks' stability, there is no consensus on its appropriateness for explaining the behaviour of LLP and non-performing loans through the business cycle.[8]

For instance, with regard to LLP, Pain (2003) wonders whether banks register in their balance sheets the full amount of any probable losses as soon as the borrower defaults (suggesting that the static model is appropriate) or whether instead they update the assessment of the probable losses according to new information in each period (suggesting

[8] Valckx (2003), ECB (2001), Cavallo and Majnoni (2002) use a static model only; Salas and Saurina (2002) prefer the dynamic equation, while Pain (2003) estimates both the static and the dynamic specifications.

that provisions are systematically related and, therefore, the dynamic specification may be better).

As far as non-performing loans are concerned, Salas and Saurina (2002) use a dynamic equation under the assumption that the one-period variable is likely to be related to that of the previous periods since problem loans are not immediately written off and they can remain in the balance sheet for a long time.

To address these issues the equations for loan loss provisions and new bad loans are re-estimated using a dynamic specification. A relevant advantage of the dynamic model is that it allows the release of the assumption of exogeneity of the regressors, which is unlikely to hold at least for some of the current levels of the bank-specific variables.

When the lagged dependent variable is included in the set of the explanatory variables, OLS estimates become inconsistent since regressors are no longer uncorrelated with the error term. These problems can be addressed by first-differencing the model, thus eliminating the individual effects, and using instrumental variable estimators such as those proposed by Anderson and Hsiao (1981) and Arellano and Bond (1991). The two procedures produce consistent estimates; however, the Arellano and Bond generalized method of the moments (GMM) estimator is more efficient and is the one used here.

Following the Arellano-Bond methodology, the differences of the strictly exogenous regressors are instrumented with themselves and the dependent and predetermined/endogenous variables are instrumented with their lagged levels.[9] In particular, while predetermined variables are instrumented using their levels lagged by one or more periods, the dependent and the other endogenous variables are instrumented with their levels lagged by two or more periods. The procedure requires there to be no second-order correlation in the differenced equation; indeed, while the presence of first-order autocorrelation in the error terms does not imply inconsistency of the estimates, the presence of second-order autocorrelation makes estimates inconsistent (Arellano and Bond, 1991).

[9] In the following analysis, a regressor x_{it} is considered: strictly exogenous if $E[x_{it}\varepsilon_{is}]=0$ for all t and s; predetermined if $E[x_{it}\varepsilon_{is}]=0$ for $s \geq t$ and $E[x_{it}\varepsilon_{is}] \neq 0$ if $s<t$; endogenous if $E[x_{it}\varepsilon_{is}]=0$ for $s>t$ and $E[x_{it}\varepsilon_{is}] \neq 0$ if $s \leq t$.

5. The models and the results

5.1 Loan loss provisions

In Italy, the rules banks must respect in the evaluation of their loans are established by Legislative Decree 87/1992 on banks' individual and consolidated accounts (implementing Directive 86/635/EEC) and by the Bank of Italy supervisory guidelines.

Loan loss provisions are typically raised on a case-by-case basis to cover potential losses on non-performing loans (specific provisions); portfolio-specific general provisions are allowed for homogeneous categories of loans, such as sectoral loans and country-risk exposures. Along with these adjustments, which are not reported as contra-assets, banks can charge general provisions to the profit and loss account to create prudential reserves; they are therefore set up against unforeseen events and do not have an asset-adjustment function, but can be computed in the Tier 2 capital up to 1.25 per cent of risk weighted assets.[10]

Since, as mentioned above, the stock of LLP may decrease not only because of an improvement in the debtors' financial conditions but also because the underlying credits are written off, the stock ratios are not necessarily timely indicators of banks' health; I therefore employ a flow rather than a stock measure.

Table 6 presents the correlation coefficients between loan loss provisions and some of the possible explanatory variables over the period 1985-2002.

It emerges that LLP are negatively related to GDP and credit growth implying that, on average, banks provision less in favourable economic times.

However, a more careful analysis shows that the correlation between LLP and GDP is not stable over time.[11] Looking at Figure 1, which plots the LLP ratio and GDP growth, it is not possible to identify a clear-cut link.

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[10] In Italy, fiscal regulations allow banks to deduct from their gross income value adjustments on credits (i.e. specific provisions) and general provisions up to 0.6 per cent of their total loans.

[11] This is not completely unexpected. Pain (2003) finds that the relationship between LLP and the business cycle for UK banks is not stable either; for instance, he notes that provisions did not increase significantly during the recession of the early 1980s.

Indeed, while the evidence for some years (e.g. 1986, 1993 and 2000) confirms that banks provision less in good times, in other periods the relationship tends to reverse and banks seem to adopt more forward-looking and counter-cyclical provisioning policies. In particular, in 2001 and 2002 LLP show a descending trend, suggesting that the recent downturn has not affected credit quality as strongly as in the past, possibly because of the lower level of interest rates or the improvement in banks' credit risk management. The slight increase in 2001 may be explained by recalling that, in that year, some important Italian banks had to make substantial provisions to deal with the crises of several Latin American countries and some international conglomerates.

5.1.1 Static model

The estimated model for loan loss provisions is the following:

$$LLP_{it} = \alpha + BSV_{it-j}\beta + MV_{t-j}\delta + u_i + \varepsilon_{it} \qquad (1)$$

i= 1,..., 207 (206 for u_i*); t= 1987,..., 2002; j= 0, 1, 2 depending on the variable*

where LLP is the loan loss provision ratio, BSV are the bank-specific variables, MV the macroeconomic indicators, u the individual unobservable effects and ε the error term.

The starting model includes the following bank specific variables:

- CREDGR (contemporaneous and lagged by 1 year) is the growth of performing loans for each bank. It might signal either a positive phase of the business cycle if it is led by demand factors (suggesting a negative sign) or an aggressive supply policy of banks, which in turn entails lower credit standards, the exposure to excessive risks and higher future provisions (suggesting a positive sign). It is therefore plausible that CREDGR will show a negative sign when current values are considered and positive when lagged (Salas and Saurina, 2002). However, the empirical evidence for other countries is somewhat mixed and does not allow me to conclude that rapid credit growth automatically implies future problems. It is interesting to note that if provisions are dynamic the contemporaneous CREDGR should have a positive effect on LLP as well.

- The cost-to-income ratio (CIRATIO) is a commonly used indicator of banks' efficiency; banks with higher values of the ratio are expected also to be less effective in the selection of borrowers and, in turn, to make higher provisions. Besides, inefficient banks may be tempted to engage in riskier lending. On the other hand, some people argue that banks that decide to undertake expensive investments to improve their borrowers' selection techniques should have less risky portfolios; if this is the case, the sign might be negative (Pain, 2003).

- The return on assets (ROA) is a measure of profitability before loan loss provisions are registered in banks' balance sheets. It can be thus used to test whether banks use provisions to smooth their income. If the income-smoothing hypothesis holds, the coefficient of the ROA should have a positive sign.

- RISKST (the ratio of the stock of non-performing loans to total loans) provides a reliable proxy for the overall quality of a bank's portfolio. The worse the creditworthiness of the customers, the higher the provisions against loan losses. One lag of the variable is included as well.

- RISKFL (the ratio of the flow of non-performing loans at t to total performing loans at t-1, i.e. the default rate) should pick up banks' ability to select good new borrowers. From a logical point of view, loan loss provisions should precede the emergence of bad debts, since the former should cover expected losses arising from loans (i.e. bad debts). In fact, provisions are often made only when losses actually materialize and their amount is typically determined on the basis of the losses experienced in the past (on this point see Laeven and Majnoni, 2003). In other words, bank management uses provisions to adjust the value of their portfolio consistently with the observed *ex-post* default rate. The expected sign is positive since banks that are not able to screen potential debtors are more likely to incur loan losses in the future.

For the macroeconomic determinants, the selected indicators are:

- GDPCC (the annual growth of real GDP) is the main and most direct measure of aggregate economic activity and, according to the prevailing view that banks do not provision in good times, it is expected to be inversely related to loan loss provisions. Along with the contemporaneous value, two lags are introduced in the specification to understand the delay with which the worsening of the real economy affects credit quality.

- BTPR is the interest rate on long-term (10-year) Italian Treasury bonds. Higher interest rates entail an increasing debt burden for banks' borrowers. Households and firms may thus have greater difficulty in paying their loans back, especially if they are hugely indebted (Benito *et al.*, 2001). On the other hand, interest rates are typically higher in expansionary phases when provisions are more likely to be low. The sign of the coefficient is therefore ambiguous.

- MIBC is the annual appreciation/depreciation of the stock exchange index and is a very rough proxy for the state of health of financial markets. In periods of bullish markets, the net wealth of households and firms tends to increase, thus making it easier to honour financial obligations (negative association). On the other hand, when the value of collateral appears particularly high, banks may be tempted to reduce their screening activity making their portfolios riskier (positive association). Finally, it is frequently found that financial markets show a boom and bust pattern (see, among the others, Hardy and Pazarbasioglu, 1999); in other words, the bullish phase might precede a sharp decline in asset prices; according to this view, one would expect a negative sign for the lagged coefficient and a positive sign for the contemporaneous one.

- The SPREAD between loan and deposit' rates is a proxy for banks' risk-taking behaviour, even though it is also affected by the degree of competition in credit/deposit markets. More generally, the widening of financial spreads may anticipate cyclical movements in aggregate activity and the increase of default risk (Davis and Henry, 1994).

Table 7 presents the regression results. Newey-West standard errors are calculated assuming an autocorrelation up to the order 2, but results are very similar when I use a higher number of lags.

Consistently with the findings of the literature, Italian banks seem to be short-sighted to a certain extent. Indeed, they reduce their provisions when credit supply (CREDGR) and

GDP (GDPCC) increase, thus reinforcing the idea that provisions are not dynamic and that intermediaries systematically under-provision during the upswing phases of the cycle. However, the coefficient of the second lag of GDP growth is larger than that of the current value, implying that the most relevant cyclical impacts are not instantaneous, but delayed and long lasting. The overall long-run partial effect of a 1 per cent change in GDP is equal to around –0.17, comparable with the values provided by Pain (2003), Valckx (2003) and Bikker and Hu (2002).

Turning to credit growth, as already mentioned it might be led by both demand and supply factors; it is therefore difficult to use such a variable to decide whether banks pursuing higher lending growth rates are more likely to accept riskier borrowers. Since this is an important issue, I re-estimate the model using a sort of abnormal growth indicator (i.e. the difference between the single bank's growth rate and the average for the banking system), which should mainly reflect supply-side determinants. The estimated coefficients for this modified indicator remain negative, indicating that it is not necessarily true that more aggressive lending policies imply a less accurate selection of customers.

As far as the profitability indicator is concerned, the positive sign of the current ROA coefficient indicates that banks tend to use provisions to stabilize their income over time, as found by Arpa *et al.* (2001), Bikker and Hu (2002) and Valckx (2003). Banks' cyclical behaviour appears therefore to be partially offset by income-smoothing policies.

Interest-rate spread shows a negative association with LLP, contrasting the hypotheses that it either proxies risk taking or anticipates cyclical downturns; however, it is worth underlining that the indicator is calculated for the banking system as a whole and can therefore hide differences across banks.

The coefficient on the Treasury bond rate (BTPR) shows a positive sign, which should support the idea that higher interest rates make it more difficult to honour financial obligations. As in previous empirical analysis financial asset prices (MIBC) show a boom and bust cycle with negative lagged coefficients and positive contemporaneous coefficients; the overall long-run effect is negative, but it does not seem particularly large.

Finally, as expected, banks provision according to the overall riskiness of their portfolio (RISKST) and to their ability to effectively select new customers (RISKFL). The past history of bad debts is therefore an important element in banks' choice of provisioning policies.

As far as the overall goodness of fit is concerned, the value of the R-squared (0.5 per cent) is acceptable and in line with the previous literature. Moreover, the model picks up the main turning points of the evolution of LLP and the confidence intervals for the (in-sample) predictions are reasonably small (Figure 2).

The fixed-effect model seems appropriate as confirmed by the Breusch-Pagan Lagrange multiplier and the Hausman tests, which reject the pooled regression and the random-effect model respectively. The F-test confirms that the individual dummies are jointly significant at any conventional level. In any case, coefficient estimates seem robust to different estimation techniques; for instance, the partial effect of GDPCC is not dramatically different in the three specifications.

In this kind of investigation the reliability of the empirical results may be undermined by the presence of structural changes. As far as Italian banks are concerned, a possible break may be due to the reform of the Banking Law in 1993 (which came into force in 1994). Unfortunately, problems of multicollinearity in sub-samples make it difficult to carry out a complete Chow test for the stability of the coefficients. However, since GDP growth is the key variable of the analysis, I include a time intercept dummy (D94 equal to 1 from 1994 and 0 otherwise) and two slope dummies for the lagged values of GDPCC (D94*L1GDPCC and D94*L2GDPCC) and test their joint significance. The coefficients of the dummies turn out to be significant, picking up some possible break; nonetheless, the good performance of the fitted values means that excessive emphasis need not to be placed on this problem.

5.1.2 Dynamic model

Although the static estimates appear very supportive of the conjecture that loan loss provisions are cyclical, the exercise is replicated including some dynamics. The resulting regression is the following:

$$LLP_{it} = \alpha + \Sigma\gamma_j LLP_{it-j} + BSV_{it-j}\beta + MV_{t-j}\delta + u_i + \varepsilon_{it} \qquad (2)$$

$i = 1,\ldots, 207$ (206 for u_i); $t = 1987,\ldots, 2002$; $j = 0, 1, 2$ depending on the variable

which, once first differenced, reduces to:

$$\Delta LLP_{it} = \Sigma\gamma_j \Delta LLP_{it-j} + \Delta BSV_{it-j}\beta + \Delta MV_{t-j}\delta + \Delta\varepsilon_{it} \quad (3)$$

The need to difference the equation reduces the time period available for the estimation by one further year. Compared with the static model, I introduce two lags of the dependent variable.

In estimating equation (3) I treat all the explanatory variables as strictly exogenous, except the contemporaneous values of the bank-specific indicators, which are treated as endogenous. In principle, some of the current macroeconomic variables might be endogenous as well, since banking system performance is likely to have second-round effects on the real economy. Granger causality tests carried out on the aggregated series generally rule out that microeconomic variables Granger cause macroeconomic ones;[12] therefore, even though Granger non-causality is weaker than the condition for exogeneity, I treat macroeconomic indicators as exogenous. Finally, since the number of instruments may become very high using the Arellano-Bond estimator, I allow up to 5 lags of the instrumented variables. The one-step estimation results for the Arellano-Bond model are reported in Table 8.

They show an acceptable convergence with the outcomes of the static exercise. The two lags of the dependent variable are significant and show the expected sign. Higher provisions in the past are therefore reflected in higher provisions now. The marginal effect is not excessively high (0.22), consistent with the fact that the dependent variable is a flow indicator. Most of the relevant bank-specific variables of the static model remain significant in the dynamic equation. Both the stock and the flow riskiness indicators are highly significant and, not surprisingly, are confirmed as the main microeconomic determinants of loan loss provisions. Interestingly, part of the information on portfolio riskiness provided by RISKST seems to be absorbed by the two lags of the dependent variable; in fact, it is plausible that they already incorporate the bank's loan quality history. The return on assets is no longer significant, indicating that the evidence of income-smoothing behaviour is not particularly robust, as suggested by previous works.

As to the macroeconomic variables, all the relevant indicators continue to be significant. In particular, the long-run effect of a 1 per cent GDP change on loan loss provisions is 0.13, as against 0.17 estimated with the static model. The 2-year delayed effect is now the only statistically significant one, reinforcing the hypothesis that banks' riskiness is slowly affected by business cycle fluctuations.

Table 8 also reports the Arellano-Bond tests for serial correlation in the differenced residuals. The tests find evidence of significant negative first-order autocorrelation, and no evidence of second-order autocorrelation. The Sargan test of over-identifying restrictions based on the two-step GMM estimator is not significant at any conventional level, failing to reject the validity of the instruments used in the analysis.[13]

5.2 New bad debts

In Italy, according to the Legislative Decree 87/1992 and the supervisory guidelines, exposures must be valued at their estimated realisable value. Loans are therefore classified as performing, substandard and bad debts depending on the intensity of the difficulties affecting the debtor. In particular, exposures are classified as bad loans when, regardless of the existence of guarantees and collateral: i) the borrower has been declared insolvent or ii) the borrower is facing serious economic difficulties that may permanently threaten his ability to pay back the loan. Notwithstanding the lack of an objective definition of bad loans, Italian banks tend to classify their exposures correctly and with appropriate timing (Moody's, 2003), making them a good indicator of the riskiness of banks' debtors. As for LLP, I use the flow measure rather than the stock; since the indicator is built up as the ratio of the loans classified as bad debts in the reference year to the performing loans outstanding at the end of the previous year, it can be interpreted as a default rate.[14]

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[12] In particular, no dependent variable Granger causes GDP growth at any conventional significance level.

[13] The Sargan test from the one-step estimator is not heteroskedasticity-consistent (see Arellano and Bond, 1991).

[14] While the use of the flow of LLP is quite common in empirical exercises (see, among others, Cavallo and Majnoni, 2002; Pain, 2003; Valckx, 2003), the flow of new bad debts is less widespread, probably because of problems of data availability.

Table 9 reports the correlation coefficients between the new bad debt ratio and the relevant micro and macroeconomic indicators.

Virtually all the macroeconomic variables are significantly correlated with banks' portfolio riskiness and, as expected, bad debts tend to decrease during upturns. However, as for loan loss provisions, the relationship is not constant over time (Figure 3).

For instance, the new bad debt ratio significantly increased during the 1993 recession, but not in the last downturn. In fact, in 2001 and 2002, notwithstanding the very negative economic conditions, bad debts did not show any significant increase. A possible explanation is that banks have improved borrower selection criteria in the last years; besides, the historically very low level of interest rates and the limited level of indebtedness may have helped firms and households to honour their debts even in such a recessionary period.

5.2.1 Static model

The estimated model is:

$$RISKFL_{it} = \alpha + BSV_{it-j}\beta + MV_{t-j}\delta + u_i + \varepsilon_{it} \qquad (4)$$

$i= 1,..., 207$ (206 for u_i); $t= 1987,..., 2002$; $j= 0, 1, 2$ depending on the variable

where RISKFL is the ratio of the flow of new bad debts to performing loans.

Most of the bank-specific variables included in model (4) are the same employed in the LLP equation and, more specifically:

- CREDGR and CIRATIO, which should behave as described for the LLP equation.
- INTM (the ratio of interest income to total assets) is a proxy for the riskiness of the loan portfolio since higher interest rates should typically be charged against lower quality credits, which are more likely to turn into bad debts (positive sign). On the other hand, as pointed out by Salas and Saurina (2002), INTM might proxy managers' incentive to switch to riskier credit policy when things turn bad (gambling for resurrection), as signalled by the curbing of the margin. According to this second interpretation, the expected sign should be negative, at least for the lagged coefficients.

- EQCAPIT (the ratio of equity capital to total assets) may be interpreted, in an agency cost framework, as a proxy for risk-taking behaviour. The higher the riskiness of the bank, the higher is the share of equity capital the shareholders have to invest to convince other stakeholders to support the bank. On the other hand, there are models suggesting that well-capitalized banks are more risk-averse.[15]

The macroeconomic indicators are the same (and with the same lag structure) as those selected for the LLP equation, namely GDP growth (GDPC), T-bond interest rate (BTPR), Stock Exchange index changes (MIBC), and the loan-deposit rates spread (SPREAD).

The results for the bad debts equation are provided in Table 10.

Three bank-specific variables (lagged CREDGR and CIRATIO and current INTM) turn out to be significant. However, while the former shows the expected sign, CIRATIO behaves in a odd way, changing its sign when lagged. The sign of CIRATIO might be justified on the basis that high values of the indicator not only reflect bank inefficiency, but also the use of more advanced, but expensive, methodologies for screening borrowers (see Pain, 2003). This explanation for the negative lagged coefficient, although appealing in this context, does not seem completely convincing. The coefficient of INTM is positive, providing some support for the Salas and Saurina story of managerial incentives to focus on riskier (but more profitable) investments in bad times; in other words, when serious problems arise, banks may decide to gamble for resurrection.

As far as the macroeconomic variables are concerned, bad debts increase in the negative phases of the business cycle; the effect of GDP growth is immediate, as suggested by previous work, but also long-lasting. In the long run, a 1 per cent GDP growth makes the new bad debt ratio decrease by 0.33 percentage points, quite close to the figure provided by Salas and Saurina. The evolution of interest rates seems to affect debtors' capacity to repay their loans, as shown by the positive coefficient of BTPR; the coefficient of the SPREAD between loan and deposit rates is not significant.

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[15] For a review, see Gambacorta and Mistrulli (2003). Data on other indicators of banks' capitalization, such as the capital buffer (i.e. the capital above the regulatory minimum), are not available for the whole period under examination.

Overall, the model fits the data sufficiently well with a value of the R-squared equal to 0.5; the comparison between actual and fitted values is also satisfactory (Figure 4).

There are some concerns about the suitability of the fixed-effect model in this case since the Hausman test fails to reject the random-effect estimates. However, the values of the coefficients in the RE regression are quite close to those of the LSDV one.[16]

5.2.2 Dynamic model

The relation between the flow of new bad debts and the business cycle is re-estimated in the context of a dynamic model. The specification is as follows:

$$RISKFL_{it} = \alpha + \Sigma\gamma_j RISKFL_{it-j} + BSV_{it-j}\beta + MV_{t-j}\delta + u_i + \varepsilon_{it} \quad (5)$$

i= 1,..., 207 (206 for u_i); t= 1987,..., 2002; j= 0, 1, 2 depending on the variable

Taking the first difference:

$$\Delta RISKFL_{it} = \Sigma\gamma j \Delta RISKFL_{it-j} + \Delta BSV_{it-j}\beta + \Delta MV_{t-j}\delta + \Delta\varepsilon_{it} \quad (6)$$

The starting model includes, along with the variable used in the static model, two lags of the dependent variable. As in the LLP equation, I consider the contemporaneous values of the banks' specific regressors as endogenous and all the other explanatory variables as exogenous. I allow up to 5 lags of the instrumented variables.

Table 11 reports the results for model (6).

The one-year lagged dependent variable is significant and, as expected, has a positive coefficient. The magnitude (0.15) is much smaller than that reported by Salas and Saurina (around 0.5), although they use the stock of bad debts, which is obviously stickier and more persistent than the flow indicator.

Apart from those for INTM, the results show a satisfactory stability in terms of the coefficients' signs, even though some of the parameters are altered in magnitude with respect to the static specification. The coefficient of INTM is now negative, which is consistent with

[16] As for the LLP equation, I carried out a test for the stability of the coefficients that failed to reject the null hypothesis of parameter constancy.

the belief that higher interest rates are charged against riskier lending; however, the differences between the static and the dynamic model make it advisable to interpret this result with caution.

For the macroeconomic variables, the effect of a 1 per cent GDP increase on the flow of new bad debts is equal to around 0.23, as against 0.33 found in the static model. Lagged SPREAD and long-term interest rates are also significant and positive, as expected on the basis of the debt burden hypothesis.

In terms of the diagnostics, Arellano-Bond tests find significant negative first-order autocorrelation and no evidence of second-order serial correlation; the Sargan test fails to reject the null hypothesis of the validity of the instruments at any conventional level.

6. Robustness checks

In this section I carry out some robustness checks. First, I use a small panel of large intermediaries to assess whether the econometric relations estimated so far are common to different categories of banks. Second, I analyze whether the effects of GDP growth are asymmetric, i.e. whether their magnitude is different during upturns and downturns.

6.1 Are large banks different?

To verify whether the results obtained in the previous section are common for different categories of banks, I re-estimate the fixed-effect models using the balanced panel of large banks. In general, I do not necessarily expect the microeconomic determinants of banks' behaviour to be exactly the same for larger intermediaries. However, I presume that the basic macroeconomic indicators remain significant and exhibit the same kind of association with the dependent variables. The results of the regressions are reported in Table 12.

The outcomes are fairly similar to those obtained with the unbalanced panel, although some of the bank-specific variables are no longer significant.

As in the unbalanced panel, provisions tend to decrease as a share of total assets when GDP grows. However, in the loan loss provisions equation, the impact of GDP growth is much smaller in magnitude with respect to the unbalanced panel. This may be interpreted as a first indication that larger banks are less affected by external factors when setting their provisioning policies. ROA is not significant; large banks do not seem to use provisions in order to smooth their income. This is consistent with the findings of the ECB (2001), but the small sample size recommends interpreting these results with caution.

Considering the new bad debt ratio, the evidence for large banks confirms that credit quality deteriorates during the recessionary phases of the business cycle; the long-run impact of GDP growth is very close to the figure obtained for the unbalanced panel. INTM is no longer significant, but the other proxy for risk-taking behaviour (EQCAPIT) turns out to be significant when lagged and shows a positive sign.

6.2 Do macroeconomic shocks have asymmetric effects?

In theory, the magnitude of the impact of GDP changes on banks' riskiness might differ depending on whether the economic system is in recessionary or expansionary phases. If this is the case, it might be appropriate to analyze this asymmetry.

To deal with this issue, I re-estimate the static specifications introducing two slope dummy variables that interact with GDP growth. The first dummy (DOWN) is equal to 1 during downswings and 0 otherwise; the second (UP), conversely, is equal to 1 during upswings and 0 otherwise. If GDP changes had asymmetric effects during expansions/recessions, the coefficients of the interaction regressors should be significantly different.

For dating the recessionary phases I rely on the studies by Altissimo *et al.* (2000) and Bruno and Otranto (2004), whose results are considered to provide a very consistent description of the evolution of the business cycle in Italy. During the period 1987-2002 they identify three main recessions: the first from March 1992 to July 1993, the second from November 1995 to November 1996, and the third at the end of 2001; I thus set DOWN equal to 1 for 1992-1993, 1996 and 2002.

Table 13 shows the coefficients of the interaction terms; the effects of the other regressors remain roughly unchanged and are therefore omitted.

For the LLP equation, the sign and the magnitude of the coefficients on the interactive dummies are quite similar in the two sub-periods. Most importantly, the F-tests fail to reject the null hypothesis that the coefficients are equal during downswings and upswings; hence, data tend to exclude significant asymmetries in banks' provisioning policies in different macroeconomic conditions.

The results are less clear-cut for the RISKFL equation. Indeed, there is some evidence of asymmetries in the transmission of the macroeconomic shocks. Apart from the 2-year lagged GDPCC, the F-tests suggest that the coefficients on GDP growth are significantly different during the business cycle fluctuations. In particular, in recessionary phases creditworthiness seems to deteriorate more heavily than it improves in expansions. However, it is worth recalling that the reduced significance of some of the coefficients may influence the results of the F-tests. This issue may be examined in greater detail in future *ad hoc* work.

7. Conclusions

Empirical observation suggests that banks behave procyclically since bad debts, provisions and loan losses are generally very low during booms. They start to be recorded at the peak of the upturn and rise significantly during the subsequent recession. This is often coupled with a contraction of earnings. The consequence is that banks tighten credit supply during downturns, thus further deepening the negative impact of the business cycle.

Several empirical works have investigated the issue of procyclicality in banking, generally concluding that banks' policies tend to be cyclical.

Following this stream of research, this paper analyzes the behaviour of more than 200 Italian banks over almost two decades to understand whether the stylized facts are confirmed in the Italian case. With respect to previous studies, this paper attempts to provide a more comprehensive framework, analyzing the evolution of loan loss provisions and new bad debts over the business cycle.

The econometric outcomes confirm that banks' loan loss provisions and new bad debts are affected by the evolution of the business cycle. The impact of recessionary conditions is significant and long-lasting.

Variation in the premise of the models leaves the sign and the significance of the macroeconomic variables basically unchanged, although the magnitude of the effects may vary. For instance, the overall long-run partial effect of a 1 per cent change of GDP on the ratio between loan loss provisions and total loans swings between 0.13 and 0.17, depending on the model; for the flow of new bad debts over performing loans, the long-run impact is in the range of 0.23-0.33. These findings are consistent with the evidence for other countries.

Moreover, data provide some support for the idea that intermediaries exploit provisioning policies to stabilize their income over time; however, the evidence on the income-smoothing hypothesis remains somewhat mixed, since the positive relation between provisions and profits is not significant in all the specifications.

Along with the macroeconomic variables, several bank-level indicators also play a role in explaining the changes in the evolution of riskiness. This corroborates the idea that the overall performance of the intermediaries is the result of the interaction between the general economic framework and banks' management.

Tables and figures

Table 1

THE SAMPLES						
	Years	**N. obs.**	**N. banks**	**Obs. per bank: min**	**Obs. per bank: max**	**Obs. per bank: avg**
Unbalanced	1985-2002	3207	207	5	18	15.5
Balanced	1985-2002	198	11	18	18	18

Table 2

SELECTED VARIABLES			
Name	**Description**		**Source**
Microeconomic			
CIRATIO	Cost-to-income ratio	%	Sup.statistics
FSERVIN	Financial services revenue / gross income	%	Sup.statistics
EQCAPIT	Equity capital / total assets	%	Sup.statistics
SIZE	Log total assets	%	Sup.statistics
ROA	ROA (operating profit / total assets)	%	Sup.statistics
LLP	Loan loss provisions (flow) / total loans	%	Sup.statistics
RISKST	Bad debts (gross of provisions) / total loans	%	Sup.statistics
RISKFL	Flow of new bad debts (t) / performing loans (t-1)	%	Credit Register
CREDGR	Credit growth	%	Sup.statistics
INTM	Interest margin / total assets	%	Sup.statistics
LLPODD	Ln (LLP / (100-LLP))		
RSKFLODD	Ln (RISKFL / (100-RISKFL))		
Macroeconomic			
MIBC	Milan Stock Exchange index - percentage change	%	Datastream
BTPR	10-year Italian T-bond rate - level	%	Bank of Italy
SPREAD	Spread between loan and deposit rate - level	%	Bank of Italy
GDPCC	GDP - percentage change	%	ISTAT

Table 3

MACROECONOMIC VARIABLES: DESCRIPTIVE STATISTICS

Variable	N. obs	Mean	STD	Min	Max	Median
MIBC	20	14.3	33.2	-27.7	104.1	14.6
BTPR	20	9.9	4.3	3.7	17.7	10.8
SPREAD	20	5.5	1.1	3.6	8.5	5.5
GDPCC	20	2.0	1.1	-0.9	3.9	2.0

Table 4

BANK-SPECIFIC VARIABLES: DESCRIPTIVE STATISTICS

Variable	N. obs	Mean	STD	Min	Max	Median
CIRATIO	3207	63,2	14,8	9,1	291,3	63,4
FSERVIN	3207	22,9	12,1	-53,4	87,6	22,6
EQCAPIT	3207	8,3	4,2	0,9	63,7	7,7
SIZE	3207	14,0	1,6	9,6	19,2	13,9
ROA	3207	1,8	0,8	-4,5	6,0	1,8
LLP	3207	1,1	1,0	0,0	7,7	0,8
RISKST	3207	6,7	5,1	0,0	37,7	5,5
RISKFL	3207	2,1	1,7	0,0	13,5	1,6
CREDGR	3207	13,3	21,1	-94,0	533,0	11,8
INTM	3207	3,7	1,2	0,0	7,1	3,7
LLPODD	3207	-4,9	1,0	-10,2	-2,5	-4,8
RSKFLODD	3207	-4,2	0,9	-8,6	-1,9	-4,1

Table 5

IPS TESTS FOR UNIT ROOTS (1)

Variable		t-bar statistics - 2 lags	
		Constant	Constant and trend
LLP	Raw data	-3.062 ***	-3.154 ***
	Demeaned	-3.276 ***	-3.417 ***
RISKFL	Raw data	-2.592 ***	-3.146 ***
	Demeaned	-3.039 ***	-3.422 ***

*, **, *** significant at the 10, 5 and 1 per cent level respectively.

Notes: (1) Im, Pesaran and Shin (2003) test for unit roots in panel data based on the mean of the individual Augmented Dickey-Fuller t-statistics of each unit in the panel (Ho: presence of a unit root). Tests are carried out on a balanced panel of 1802 obs. (Stata routine provided by C. F. Baum and F. Bornhorst).

Table 6

LOAN LOSS PROVISIONS - CORRELATION COEFFICIENTS

	LLP	CREDGR	CIRATIO	ROA	RISKST	RISKFL	GDPCC	L1GDPCC	L2GDPCC	BTPR	MIBC	SPREAD
LLP	1,000											
CREDGR	**-0,148**	1,000										
CIRATIO	**0,128**	0,029	1,000									
ROA	-0,028	0,012	**-0,656**	1,000								
RISKST	**0,444**	**-0,211**	**0,169**	**-0,168**	1,000							
RISKFL	**0,419**	**-0,046**	**0,064**	0,018	**0,505**	1,000						
GDPCC	**-0,124**	**0,108**	-0,025	**0,058**	**0,062**	**-0,086**	1,000					
L1GDPCC	**-0,178**	**0,099**	**-0,083**	**0,104**	-0,048	**-0,119**	**0,364**	1,000				
L2GDPCC	**-0,206**	**0,060**	-0,049	**0,042**	**-0,110**	**-0,107**	**-0,066**	**0,341**	1,000			
BTPR	**-0,062**	**0,059**	**-0,063**	**0,219**	-0,043	**0,228**	**0,220**	**0,106**	**0,080**	1,000		
MIBC	0,016	-0,018	-0,022	**0,065**	**0,084**	**0,117**	**0,130**	**-0,018**	**-0,151**	-0,016	1,000	
SPREAD	-0,034	0,009	-0,034	**0,183**	-0,042	**0,192**	0,011	**0,089**	**0,069**	**0,826**	**-0,157**	1,000

Coefficients in bold are significant at the 5 per cent level.

Table 7

ECONOMETRIC RESULTS - UNBALANCED PANEL
LOAN LOSS PROVISIONS - STATIC SPECIFICATION (1)

Explanatory variable	Exp. sign	Fixed effects (LSDV) Coeffic.	N-W SE (2)	Sign. lev.	Pooled regression Coeffic.	N-W SE (2)	Sign. lev.	Random effects Coeffic.	SE	Sign. lev.
Intercept		0,9780	0,1911	***	1,1825	0,1181	***	1,1864	0,1112	***
BANK SPECIFIC										
CREDGR	+/-	-0,0109	0,0015	***	-0,0064	0,0020	***	-0,0074	0,0010	***
Lag1CREDGR	+/-	-0,0054	0,0016	***	-0,0017	0,0012		-0,0023	0,0009	***
CIRATIO	+									
Lag1CIRATIO	+									
ROA	+	0,1487	0,0411	***	0,0846	0,3011	***	0,9633	0,0237	***
RISKST	+									
Lag1RISKST	+	0,5541	0,0073	***	0,0443	0,0061	***	0,0479	0,0044	***
RISKFL	+	0,1907	0,0212	***	0,1797	0,0206	***	0,1842	0,0118	***
Lag1RISKFL	+	0,0600	0,0187	***	0,0701	0,0178	***			
MACRO										
BTPR	+/-	0,0204	0,0081	**	0,0207	0,0087	**	0,1945	0,0078	**
Lag1BTPR	+/-									
MIBC	+	0,0048	0,0006	***	0,0049	0,0007	***	0,0048	0,0006	***
Lag1MIBC	-	-0,0045	0,0006	***	-0,0042	0,0006	***	-0,0043	0,0006	***
SPREAD	+	-0,1373	0,0246	***	-0,1315	0,2479	***	-0,1332	0,0245	***
Lag1SPREAD	+									
GDPCC	-	-0,0427	0,0178	**	-0,0389	0,1922	**	-0,0421	0,0149	***
Lag1GDPCC	-									
Lag2GDPCC	-	-0,1260	0,0152	***	-0,1307	0,0174	***	-0,1335	0,0138	***
Nr. Obs.		2642			2642			2642		
R2		0,51			0,37					
Wald-test (3)		F (12, 2424) =55.31		***	F (12, 2629) = 59.22		***	Chi2 (12) = 1357.49		***
F-test all FE=0		F (205, 2424) =3.26		***						
B-P LM (4)					Chi2 (1) = 188.29		***			
Hausman (5)								Chi2 (12) = 141.96		***
Panel-hetero (6)		Chi2 (206) = 2.2e+31		***						
Panel-AR (1) (7)		F (1, 200) = 4.682		**						

*, **, *** significant at the 10, 5 and 1 per cent level respectively.

Notes: (1) Static model in which the ratio of loan loss provisions to total loans is the dependent variable. The most parsimonious specification of the LSDV model has been selected by a general-to-simple approach. The coefficients of the individual effects are not reported. (2) Newey-West robust standard errors; the errors are assumed to be heteroskedastic and autocorrelated up to 2 lags (Stata routine provided by D. Roodman). (3) Wald test that all the coefficients (except intercept and FE) are jointly not significant. (4) Breusch-Pagan Lagrange multiplier test for the pooled regression (Ho: pooled regression against Ha: RE). (5) Hausman test for random effects (Ho: RE against Ha: FE). (6) Modified Wald statistic for groupwise heteroskedasticity in fixed effect model (Stata routine provided by C. F. Baum). (7) Wooldridge-test for first order serial correlation (Stata routine provided by D. M. Drukker).

Table 8

ECONOMETRIC RESULTS - UNBALANCED PANEL
LOAN LOSS PROVISIONS - DYNAMIC SPECIFICATION (1)

Explanatory variable	Exp. sign	First-differenced equation Coeffic.	Robust SE (2)	Sign. lev.
BANK SPECIFIC				
Lag1LLP	+	0,1715	0,0390	***
Lag2LLP	+	0,0506	0,0239	**
CREDGR	+/-	-0,0073	0,0021	***
Lag1CREDGR	+/-			
CIRATIO	+			
Lag1CIRATIO	+			
ROA	+			
RISKST	+			
Lag1RISKST	+	0,0499	0,0136	***
RISKFL	+	0,2329	0,0421	***
Lag1RISKFL	+			
MACRO				
BTPR	+/-			
Lag1BTPR	+/-	-0,2401	0,1199	**
MIBC	+	0,0026	0,0008	***
Lag1MIBC	-	-0,0044	0,0006	***
SPREAD	+	-0,0785	0,0237	***
Lag1SPREAD	+	0,1117	0,0384	***
GDPCC	-			
Lag1GDPCC	-			
Lag2GDPCC	-	-0,1295	0,0186	***
Nr. Obs.		2400		
Wald-test (3)		Chi2(8) = 189.32		***
Sargan (4)		Chi2(270) = 195.36		
Arellano-Bond AR (1) (5)		z = -8.23		***
Arellano-Bond AR (2) (5)		z = 1.09		

*, **, *** significant at the 10, 5 and 1 per cent level respectively.

Notes: (1) Dynamic (first differenced) model in which the ratio of loan loss provisions to total loans is the dependent variable. The results are from the one-step GMM estimator. All the regressors are treated as exogenous, except the contemporaneous bank-specific variables that are considered endogenous. The most parsimonious specification has been selected by a general-to-simple approach. (2) Heteroskedasticity robust standard errors. (3) Wald test that all the coefficients are jointly not significant. (4) Sargan test of over-identifying restrictions from the two-step estimator. (5) Arellano-Bond test for first and second-order autocorrelation in the residuals.

Table 9

FLOW OF NEW BAD DEBTS: CORRELATION COEFFICIENTS

	RISKFL	CREDGR	CIRATIO	INTM	EQCAPIT	GDPCC	L1GDPCC	L2GDPCC	BTPR	MIBC	SPREAD
RISKFL	1,000										
CREDGR	**-0,046**	1,000									
CIRATIO	**0,064**	0,029	1,000								
INTM	**0,193**	-0,010	**-0,127**	1,000							
EQCAPIT	0,038	-0,035	**-0,081**	**0,170**	1,000						
GDPCC	**-0,086**	**0,108**	-0,025	**0,063**	**-0,191**	1,000					
L1GDPCC	**-0,119**	**0,099**	**-0,083**	**0,072**	**-0,206**	**0,364**	1,000				
L2GDPCC	**-0,107**	**0,060**	-0,049	**0,038**	**-0,147**	**-0,066**	**0,341**	1,000			
BTPR	**0,228**	**0,059**	**-0,063**	**0,420**	**-0,171**	**0,220**	**0,106**	**0,080**	1,000		
MIBC	**0,117**	-0,018	-0,022	**0,053**	**-0,112**	**0,130**	**-0,018**	**-0,151**	-0,016	1,000	
SPREAD	**0,192**	0,009	-0,034	**0,391**	**-0,093**	0,011	**0,089**	**0,069**	**0,826**	**-0,157**	1,000

Coefficients in bold are significant at the 5 per cent level.

Table 10

ECONOMETRIC RESULTS - UNBALANCED PANEL FLOW OF NEW BAD DEBTS - STATIC SPECIFICATION										
		Fixed effects (LSDV)			**Pooled regression**			**Random effects**		
Explanatory variable	**Exp. sign**	**Coeffic.**	**N-W SE (2)**	**Sign. lev.**	**Coeffic.**	**N-W SE (2)**	**Sign. lev.**	**Coeffic.**	**SE**	**Sign. lev.**
Intercept		1,9333	0,3977	***	0,8743	0,2749	***	1,1270	0,2693	***
BANK SPECIFIC										
CREDGR	+/-									
Lag1CREDGR	+/-	-0,0065	0,0024	***	-0,0069	0,0023	***	-0,0061	0,0015	***
CIRATIO	+	0,0102	0,0027	***	0,0160	0,0033	***	0,0122	0,0027	***
Lag1CIRATIO	+	-0,0153	0,0042	***	-0,0144	0,0037	***	-0,0138	0,0031	***
INTM	+									
Lag1INTM	+	0,1427	0,0651	**	0,1509	0,0455	***	0,1498	0,0396	***
EQCAPIT	+/-									
Lag1EQCAPIT	+/-									
MACRO										
BTPR	+/-									
Lag1BTPR	+/-	0,1249	0,0117	***	0,1256	0,0117	***	0,1245	0,0095	***
MIBC	+	0,0039	0,0011	***	0,0035	0,0012	***	0,0038	0,0010	***
Lag1MIBC	-	0,0034	0,0010	***	0,0032	0,0010	***	0,0034	0,0010	***
SPREAD	+									
Lag1SPREAD	+									
GDPCC	-	-0,1044	0,0242	***	-0,1078	0,0284	***	-0,1037	0,0241	***
Lag1GDPCC	-	-0,1274	0,0251	***	-0,1312	0,0311	***	-0,1277	0,0264	***
Lag2GDPCC	-	-0,1141	0,0254	***	-0,1106	0,0325	***	-0,1120	0,0234	***
Nr. Obs.		2642			2642			2642		
R2		0,49			0,16					
Wald-test (3)		F(10, 2426) = 60.01		***	F(10, 2631) = 46.00		***	Chi2 (10) = 662.87		***
F-test all FE=0		F (205, 2426) = 7.99		***						
B-P LM (4)					Chi2 (1) = 1859.08		***			
Hausman (5)								Chi2 (10) = 11.40		
Panel-hetero (6)		Chi2 (206) = 1.3e+32		***						
Panel-AR (1) (7)		F(1, 200) = 24.175		***						

*, **, *** significant at the 10, 5 and 1 per cent level respectively.

Notes: (1) Static model in which the ratio of the flow of new bad debts to total loans is the dependent variable. The most parsimonious specification of the LSDV model has been selected by a general-to-simple approach. The coefficients of the individual effects are not reported. (2) Newey-West robust standard errors; the errors are assumed to be heteroskedastic and autocorrelated up to 2 lags (Stata routine provided by D. Roodman). (3) Wald test that all the coefficients (except intercept and FE) are jointly not significant. (4) Breusch-Pagan Lagrange multiplier test for the pooled regression (Ho: pooled regression against Ha: RE). (5) Hausman test for random effects (Ho: RE against Ha: FE). (6) Modified Wald statistic for groupwise heteroskedasticity in fixed effect model (Stata routine provided by C. F. Baum). (7) Wooldridge test for first-order serial correlation (Stata routine provided by D. M. Drukker).

ECONOMETRIC RESULTS - UNBALANCED PANEL
FLOW OF NEW BAD DEBTS - DYNAMIC SPECIFICATION (1)

		First-differenced equation		
Explanatory variable	**Exp. sign**	**Coeffic.**	**Robust SE (2)**	**Sign. lev.**
BANK SPECIFIC				
Lag1RISKFL	+	0,1538	0,0320	***
Lag2RISKFL	+			
CREDGR	+/-			
Lag1CREDGR	+/-	-0,0079	0,0029	***
CIRATIO	+			
Lag1CIRATIO	+	-0,0138	0,0053	***
INTM	+	-0,4260	0,1565	***
Lag1INTM	+			
EQCAPIT	+/-			
Lag1EQCAPIT	+/-			
MACRO				
BTPR	+/-			
Lag1BTPR	+/-	0,1418	0,0301	***
MIBC	+			
Lag1MIBC	-	0,0031	0,0009	***
SPREAD	+			
Lag1SPREAD	+	0,2688	0,0494	***
GDPCC	-			
Lag1GDPCC	-	-0,1536	0,0260	***
Lag2GDPCC	-	-0,0761	0,0289	***
Nr. Obs.		2400		
Wald-test (3)		Chi2(8) = 203.07		***
Sargan (4)		Chi2(202) = 198.05		
Arellano-Bond AR (1) (5)		z = -7.29		***
Arellano-Bond AR (2) (5)		z = 0.74		

*, **, *** significant at the 10, 5 and 1 per cent level respectively.

Notes: (1) Dynamic (first differenced) model in which the ratio of the flow of new bad debts to total loans is the dependent variable. The results are from the one-step GMM estimator. All the regressors are treated as exogenous, except the contemporaneous bank-specific variables that are considered endogenous. The most parsimonious specification has been selected by a general-to-simple approach. (2) Heteroskedasticity robust standard errors. (3) Wald test that all the coefficients are jointly not significant. (4) Sargan test of over-identifying restrictions from the two-step estimator. (5) Arellano-Bond test for first and second-order autocorrelation in the residuals.

Table 12

ECONOMETRIC RESULTS - BALANCED PANEL
FIXED EFFECTS (LSDV) (1)

Explanatory variable	Loan loss provisions Coeffic.	Loan loss provisions N-W SE (2)	Loan loss provisions Sign. lev.	New bad debts Coeffic.	New bad debts N-W SE (2)	New bad debts Sign. lev.
Intercept						
BANK SPECIFIC						
CREDGR	-0,0160	0,0066	**			
Lag1CREDGR				-0,0173	0,0073	**
CIRATIO				0,0275	0,0107	**
Lag1CIRATIO				-0,0286	0,0129	**
ROA						
RISKST	0,0501	0,0180	***			
Lag1RISKST						
RISKFL	0,1478	0,7066	**			
Lag1RISKFL						
INTM						
Lag1INTM						
EQCAPIT						
Lag1EQCAPIT				0,1396	0,0746	**
FSERVIN						
MACRO						
BTPR	0,0913	0,0333	***			
Lag1BTPR	-0,0704	0,0252	***	0,1711	0,0238	***
MIBC	0,0051	0,0016	***	0,0098	0,0030	***
Lag1MIBC	-0,0042	0,0018	**	0,0066	0,0025	***
SPREAD	-0,1451	0,0555	***			
Lag1SPREAD						
GDPCC				-0,2231	0,0550	***
Lag1GDPCC						
Lag2GDPCC	-0,0734	0,0406	*	-0,1665	0,0464	***
Nr. Obs.	176			176		
R2	0,57			0,77		
Wald-test (3)	F(18, 147) = 4.29		***	F(9, 156) = 17.01		***
F-test all FE=0	F(10, 156) = 3.78		***	F(10, 156) = 19.17		***
Panel-hetero (4)	Chi2 (11)= 279.54		***	Chi2 (11) = 562.77		***
Panel-AR (1) (5)	F(1, 10) = 1.576			F(1, 10) = 0.555		

*, **, *** significant at the 10, 5 and 1 per cent level respectively.

Notes: (1) Grey areas denote the variables included in the most general specification for each equation; the most parsimonious specification has been selected by a general-to-simple approach. The coefficients of the individual effects are not reported. (2) Newey-West standard errors; the errors are assumed to be heteroskedastic and autocorrelated up to 2 lags (Stata routine provided by D. Roodman). (3) Wald test that all the coefficients (except intercept and FE) are jointly not significant. (4) Modified Wald statistic for groupwise heteroskedasticity in fixed effect model (Stata routine provided by C. F. Baum). (5) Wooldridge test for first-order serial correlation (Stata routine provided by D. M. Drukker).

Table 13

IMPACT OF GDP GROWTH DURING DOWNTURNS/UPTURNS (1)

	GDPCC*		L1GDPCC*		L2GDPCC*	
	DOWN	**UP**	**DOWN**	**UP**	**DOWN**	**UP**
LLP equation	-0,029	-0.046 (**)			-0.131 (***)	-0.127 (***)
F-test down=up (2)	F(1, 2422) = 0.09				F(1, 2422) = 0.03	
RISKFL equation	-0.491 (***)	-0.052	0,149	-0.146 (***)	-0.222 (***)	-0.096 (***)
F-test down=up (2)	F(1, 2423) = 10.85 (***)		F(1, 2423) = 6.47 (**)		F(1, 2423) = 2.07	

*, **, *** significant at the 10, 5 and 1 per cent level respectively.

Notes: (1) The table reports the coefficients of GDP growth for the static models in different phases of the business cycle. Two intercept dummies interact with GDPCC, L1GDPCC and L2GDPCC: DOWN equal to 1 during recessions (1992, 1993, 1996 and 2002) and 0 otherwise; UP equal to 1 during expansions and 0 otherwise. (2) F-test that the coefficients of DOWN*GDPCC and UP*GDPCC (DOWN*L1GDPCC and UP*L1GDPCC; DOWN*L2GDPCC and UP*L2GDPCC) are equal each other.

FIGURE 1 - LOAN LOSS PROVISIONS OVER THE BUSINESS CYCLE

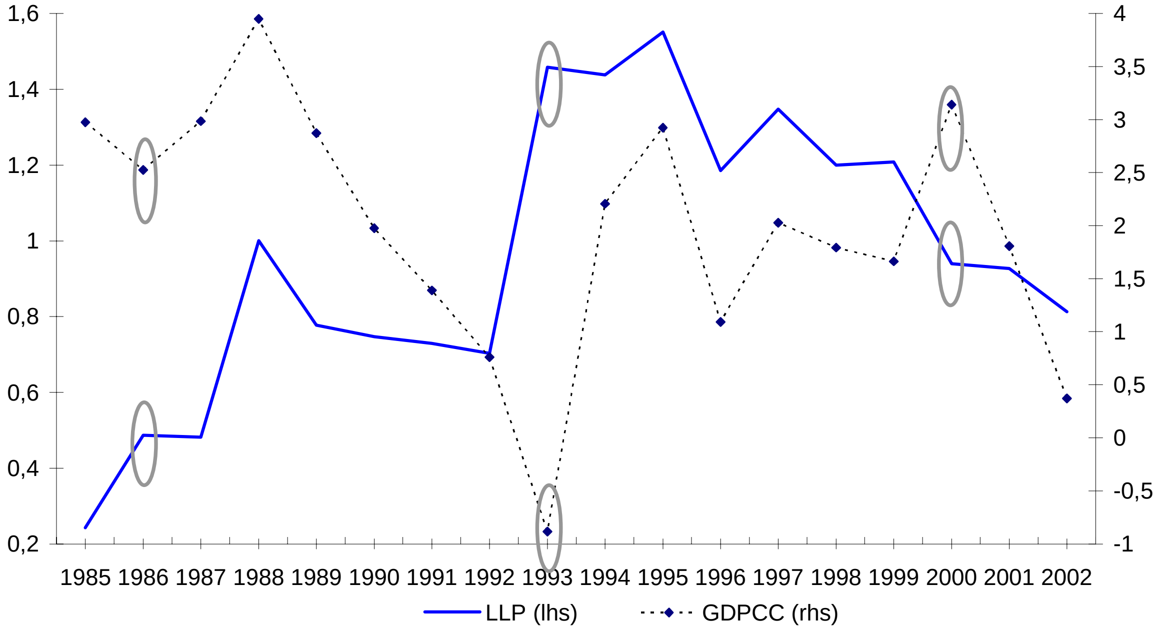


FIGURE 2 - LLP - STATIC MODEL
Actual and fitted values
(averaged across banks)

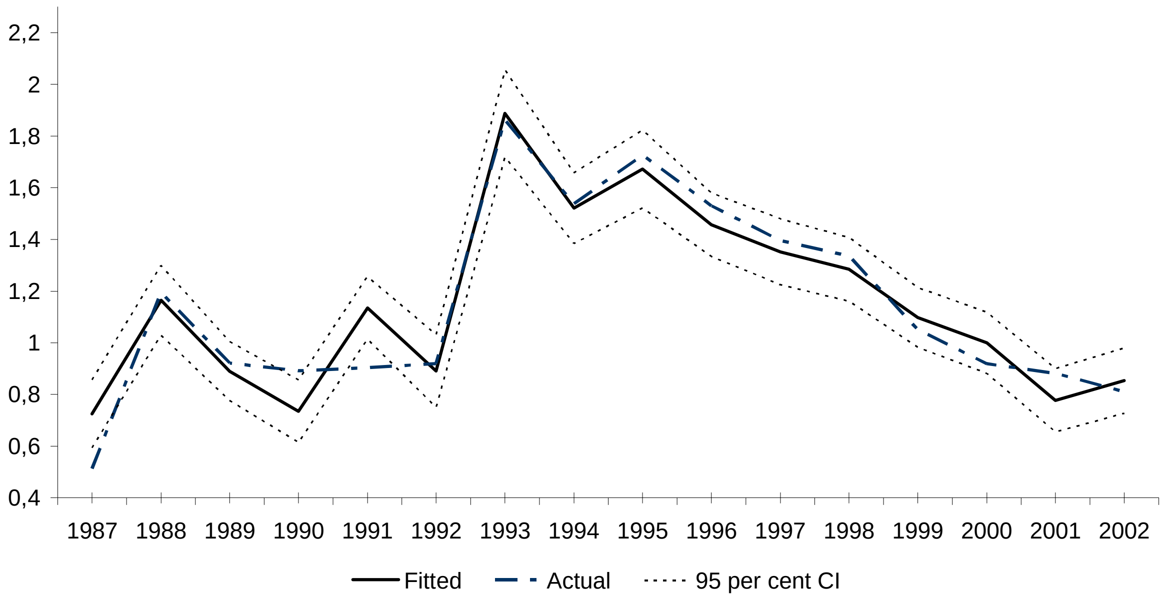


FIGURE 3 - NEW BAD DEBTS OVER THE BUSINESS CYCLE

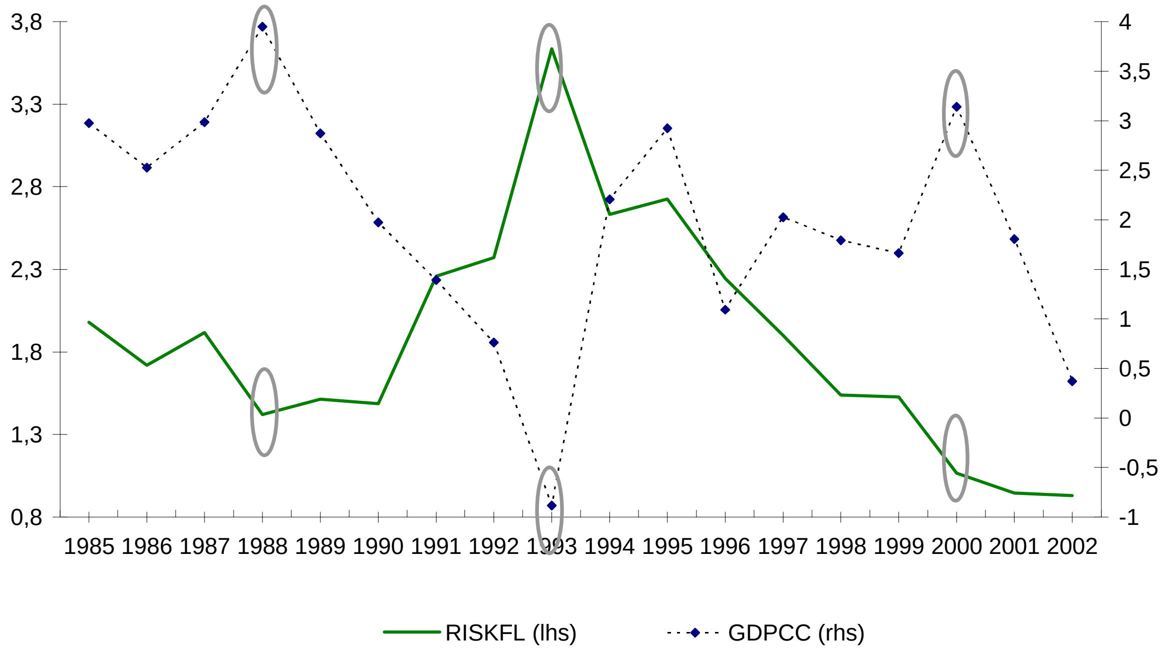
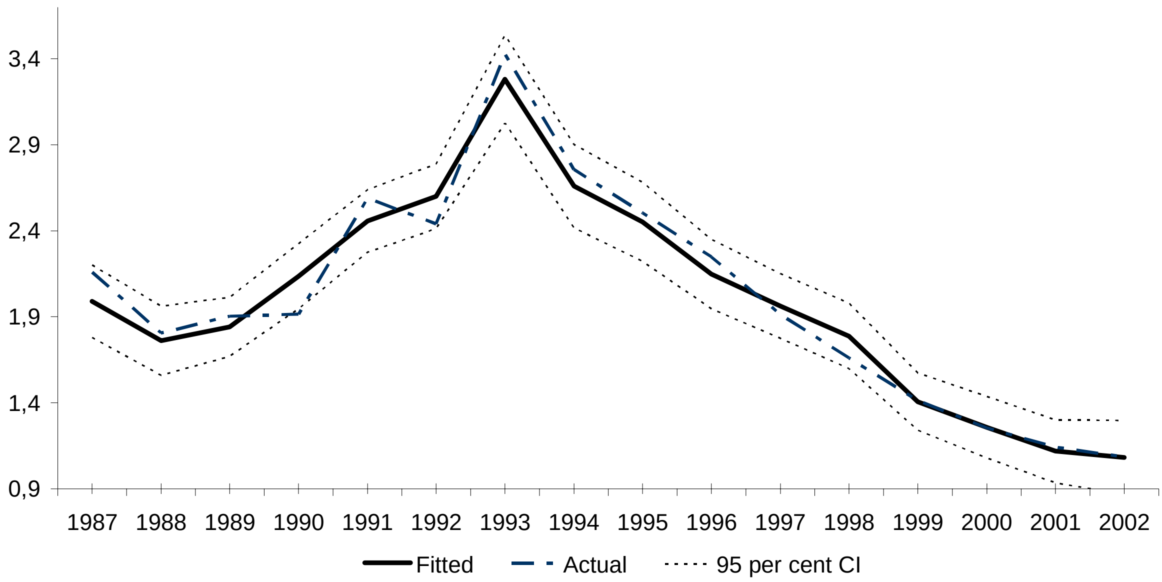


FIGURE 4 - NEW BAD DEBTS - STATIC MODEL
Actual and fitted values
(averaged across banks)



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