Centre for International Capital Markets

Discussion Papers
ISSN 1749-3412

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No 2014-01

Bank Lending Procyclicality And Credit Quality During Financial Crises[1]

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June 2013

Abstract

This paper analyses macroeconomic and financial determinants of bad loans applying a SVAR approach to investigate whether excessive loans granted during expansionary phases can explain the more than proportional increase in non-performing loans during contractionary periods. The results indicate that the effects of a permanent shock to bad loans on the excess of credit are significant and persistent for bad loans to firms, but not for bad loans to households or in the case of Cooperative Credit Banks, who adopt more efficient lending policies.

Keywords: loan losses, macroeconomic determinants, Italian banking system, SVAR.
JEL classification: E44, G01, G21, C22.

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[1] The views expressed in this paper are our own and do not necessarily reflect those of Federcasse. We are grateful to Davide Ciferri, Matteo Alessi, Yiorgos Alexopoulos, Francesco Cesarini, Fabio Di Nicolò, Roberto Di Salvo, Anna Di Trapano, Silvio Goglio, Giuseppe Lusignani, Iris Pennisi, Andrea Pezzotta, Cristiana Schena and the participants in the "XX International Conference in Banking and Finance" at the University of Rome Tor Vergata (Rome, December 2011) and in the "International Conference on the Global Financial Crisis" at the University of Southampton (Southampton, April 2013) for useful comments and suggestions.

1. Introduction

There is a large empirical literature showing the growth rate of loans tends to be positive during booms and negative during contractions[2], with loan losses typically growing more than proportionately during the latter[3]. As a result, periods of fast loan growth are followed by periods characterised by a sharp deterioration in credit quality. If there is a positive shift in the demand for credit, banks can increase lending in two ways, either reducing interest rates or lowering the credit screening criteria for new loans. The latter leads to an increase in the number of potential borrowers, some of which would have previously been excluded as not sufficiently creditworthy. Such borrowers have a higher probability of not being able to repay their debt, which increases the overall probability of default. When the economy slows down, the profitability of firms tends to fall, and consequently unemployment rises and household disposable income decreases, further eroding corporate profits. This generates a vicious circle: the financial position of borrowers (both firms and households) worsens and some of them are unable to repay their debt.

Following Bofondi and Ropele (2011), the present paper analyses macroeconomic and financial determinants of bad loans applying a SVAR approach to investigate whether excessive loans granted during expansionary phases can explain the more than proportional increase in non-performing loans during contractionary periods.

The paper is structured as follows: Section 2 briefly reviews the relevant empirical literature, Section 3 describes the data and some preliminary statistics, Section 4 discusses the empirical results, and Section 5 offers some concluding remarks.

2. A brief review of the literature

The dynamic relationship between macroeconomic factors and the quality of loans has been investigated in a large body of literature. One of the first contributions is the study by Keeton and Morris (1987), who estimated a simple linear regression to examine the macroeconomic determinants of credit losses in a sample of 2,500 US commercial banks in the period 1979-1985. They found that a significant proportion of loan losses was due to the particularly poor performance of some regions and sectors such as agriculture and energy.

Gavin and Hausmann (1996) examined how macroeconomic trends contributed to the banking crises in Latin America during the '90s. They considered domestic interest rates, expected

[2] For the Italian banking system see Di Giulio (2009), Paolazzi and Rapacciuolo (2009), Panetta and Signoretti (2010), Di Colli and Girardi (2010).
[3] See Bofondi and Ropele (2011) and Keeton and Morris (1987).

inflation, disposable income and the growth of bank lending, also taking into account monetary policy rules and exchange rate regimes, and concluded that worsening macroeconomic conditions are a predictor for banking crises in many countries.

Demirgüç-Kunt and Detragiache (1998) and Hardy and Pazarbaşioğlu (1998) showed that bank failures can be attributed to macroeconomic shocks. In particular, the former analysed the macroeconomic determinants of banking crises using four different specifications of a multivariate logit model for a large sample of developed and developing countries during the period from 1980 to 1994. Inflation and interest rates were found to be positively correlated with banking crises, while the correlation with GDP appeared to be negative. Hardy and Pazarbaşioğlu (1998) focused instead on the identification of macroeconomic and financial conditions which are related to a stressful situation in the banking sector. They analysed a panel of 38 countries using a multinomial logit specification. The main result was that the failures in the banking sector are likely to be linked to slow economic growth.

Gambera (2000) used a VAR methodology to assess the impact of macroeconomic variables on bank loans at both national and regional level, using data on US commercial banks. He considered variables such as unemployment, income from the agricultural sector, GDP, the number of bankruptcy cases and sales of automobiles, and found that all of them, with the exception of car sales, are good predictors for the quality of loans.

Bikker and Metzemakers (2005) investigated the relationship between credit quality as measured by the stock of credit provisions, macroeconomic variables and banking. They concluded that a reversal of the economic cycle leads to a worsening of bank asset quality. All variables they considered significantly affected credit quality. Similar evidence is reported by Arpa et al. (2001), who examined banking sector cyclicality with a related approach, and Hoggarth et al. (2005), who used quarterly data for the UK during the period 1988-2004 to investigate the relationship between credit losses and several macroeconomic variables.

Baboucek and Jancar (2005) estimated an unrestricted VAR using monthly data from 1993 to 2006 to quantify the effects of macroeconomic shocks on the quality of the Czech banking sector. They used the bad loan to loans ratio as an indicator of credit quality and several macroeconomic variables. Having identified the main macroeconomic determinants of that ratio, they carried out simulations to measure the vulnerability to macroeconomic shocks of the Czech banking sector.

Filosa (2007) performed similar stress tests on the Italian banking system using a VAR specification including three endogenous variables (the default rate, default loans to loans and net interest income) and three exogenous variables (the interest rate, the exchange rate and a linear trend). He concluded that the procyclicality of these variables is not a crucial factor for the Italian

banking sector. A stress test on monetary conditions highlighted the great exposure to this type of shock.

A very influential contribution was the study by Bofondi and Ropele (2011), who tested the macroeconomic determinants of credit quality measured by adjusted new bad debts. We follow their approach in the empirical analysis below.

3. Preliminary data analysis

3.1 Data description

Our dataset consists of 17 monthly series (see Table 1 for a complete list) over the sample period from June 1998 to June 2012 (169 observations). The data sources are the Data Warehouses of the Bank of Italy[4], Istat (the Italian Office for National Statistics), the European Central Bank and Bloomberg.

The data can be divided into two subsets. The first comprises the banking variables, such as loans and bad loans at the national level, including total bad loans and loans (excluding bad loans), bad loans and loans (excluding bad loans) to firms, bad loans and loans (excluding bad loans) to households of all Italian banks and bad loans and loans (excluded bad loans) only for the subset of Italian Cooperative Credit Banks (SOFF_ITA, IMP_ITA, SOFF_FIR_ITA, IMP_FIR_ITA, SOFF_HOU_ITA, IMP_HOU_ITA, SOF_BCC, IMP_BCC; see Table 1). All the variables have been deflated.

The second one consists of macroeconomic and financial variables. In particular, following Bofondi and Ropele (2011), these have been chosen to represent the following five main categories: 1) general state of the economy, 2) price stability, 3) cost of debt, 4) financial and real wealth, 5) trends affecting the economic situation.

The indicators for the general situation of the economy are the annual growth rates of the industrial production index (IPI_ITA) and of the retail sale index (RET_SALES_ITA) as well as the unemployment rate (UNEMR_ITA). A higher index of industrial production indicates an improvement in economic activity. It is typically correlated with growth in corporate profitability, while a higher retail sale index is normally associated to higher consumption. The unemployment rate has a negative relationship with current and prospective household disposable income. The expected sign of the relationship with bad loans is negative for industrial production and retail sales and positive for the unemployment rate.

[4] BIP ("Base Informativa Pubblica", see http://bip.bancaditalia.it/4972unix/homebipita.htm),

Price stability is measured by the annual growth index of consumer prices (CPI_ITA). As mentioned by Bofondi and Ropele (2011), its relationship with credit quality is not clear. On the one hand, it reduces the costs associated with high inflation, such as the opportunity cost of money, tax distortions, money illusion, and greater riskiness of financial assets. On the other hand, high inflation helps debtors by reducing the real value of their debt. On this point the literature has provided conflicting evidence. In particular, Shu (2002) found a negative relationship between inflation and bad loans, whilst Rinaldi and Sanchis - Arellano (2006) estimated a positive sign.

The cost of debt is measured by the short-term interbank 3-month Euribor rate (EURIBOR_3M), while for the long term we have chosen the 10-year interest rate swaps (IRS_10Y). The expected effect of an increase of short-and long-term interest rates on bad loans is positive, since the higher cost of short and long-term debt worsens the financial situation of debtors. At the same time, a decrease in interest rates (a monetary expansion) may follow a cyclical downturn. In this case, the expected relationship between bad loans and loans is negative. Again, the sign of the relationship with credit quality cannot be established a priori.

The real and financial wealth indicators are the house price index (yearly rate of change, HOUS_PRI_ITA) and the main Italian stock index, the FTSE Mib (FTSE_MIB, yearly rate of change). In general, the growth of stock indexes reflects, among other things, an improvement in the current and future profitability of listed companies (and indirectly, even of those not listed who have economic relations with them) and greater household wealth. An increase in house prices improves household wealth, the value of the capital stock of firms and the value of collaterals for borrowers. Therefore, both variables should be positively correlated to credit quality (and negatively with bad loans).

Finally, the variable chosen as a proxy for the state of the economy is the slope of the term structure of interest rates, namely the difference between the 10-year IRS and the 3-month Euribor rate (SLOPE_3M_10Y). A steeper curve can be interpreted as an improvement in the expectations on future economic growth. The expected sign of the relationship between this variable and bad loans is negative.

3.2 Preliminary statistical analysis

The credit quality of the Italian banking system is assessed here using monthly data on bad loans over the period from June 1998 to June 2012. Bad loans are defined as credit positions related to

customers characterised by a "status of persistent financial instability such that credit recovery could be obstructed[5]".

Figures 1a – 1c show the quarterly rate of change (on an annual basis) of bad loans during the period from July 1998 to July 2012. The sample period includes three recessions in Italy (defined as periods in which GDP declined for at least two consecutive quarters), namely those of June 2001 – December 2002, June 2008 – June 2009 and September 2011 – June 2012 (the first two of which were double-dip recessions). In all figures these three recessions correspond to the grey areas.

Figures 2a and 2b show quite clearly the negative relationship between bad loans and total loans (both in the full sample with all the banks and in the subset with only the Cooperative Credit Banks). When the latter fall (during a recession) the former tend to grow sharply. This negative correlation is related to the business cycle, as mentioned before. In particular, bad loans decreased until June 2001 for the banking system as a whole, while they grew at a declining rate for the subset of CCBs. During the same period, the growth rate of total loans without bad loans increased slowly for all banks and decreased for the Cooperative Credit Banks.

From June 2001 to December 2002, a recession occurred and bad loans started to grow sharply while the rates of change of loans continued to be positive, but declining for banks. There was also considerable persistence: bad loans continued to grow until June 2004, i.e. two years after the end of the recession, while loans were more stable around a lower (on average) growth rate. For the CCBs, however, bad loans grew more gradually up to June 2005, with the exception of an abnormal reduction in June 2002 due to a securitisation procedure.

Between June 2004 and December 2007, bad loans of all banks remained stable (with a growth rate between 0 and 5%) while lending grew gradually. In particular, two troughs are quite evident in Figure 1d: in June 2001 and between December 2005 and December 2006. The first corresponds to the expiry of the deadline for the receipt of tax benefits provided by the Law 130/99[6]. The second one is related to the increase in the securitisation process that preceded the entry of IAS / IFRS (8.585 billion euros of securitisations in 2005 with respect to 335 million in 2004[7]). Furthermore, during the recessions of 2008 – 2009 and 2011-212, bad loans rose sharply, for both the banking system as a whole and the CCBs, while loans decreased rather abruptly for the former and more gradually for the latter (consistently with the literature on the anti-cyclicality of

[5] Bank of Italy n. 139/1991: "status di persistente instabilità patrimoniale e finanziaria idonea a intralciare il recupero del credito da parte dell'intermediario".
[6] The Bank of Italy Governor Annual Report for 2001.
[7] The Bank of Italy Governor Annual Report for 2005.

loans of Cooperative Banks[8]). Overall, Figures 2a – 2b offer some preliminary evidence that bad loans and loans are inversely related to the economic cycle.

The main features of the statistical distributions of the series described before are shown in Table 2. Figure 3a shows the original series, many of which appear to be non-stationary. Augmented Dickey-Fuller (Dickey and Fuller, 1979), KPSS (Kwiatkowsky – Phillips – Schmidt – Shin) and Phillips – Perron (Phillips and Perron, 1988) tests [9] suggest in most cases the presence of unit roots, except for year-over-year rate of change of industrial production and the consumer price index. Therefore, logarithmic first differences have been taken (see Figure 3b). The series have also been standardised to allow comparisons.

The one-year dynamic cross-correlations between bad loans and loans and the other macroeconomic and financial variables are reported in Tables 4a and 4b. The relationship between bad loans and loans is negative in most cases and the highest correlation can be observed at lag six, as one would expect (see Keeton, 1999). When the economy performs well, banks provide more credit and bad loans grow slowly, proportionally less than loans. During downturns, the growth rate of loans decreases or becomes negative (credit squeeze), while that of non-performing loans rises above its long-term average because of the worsening financial conditions of borrowers. Therefore, the estimated negative sign (see the dynamic correlation matrix, Tables 4a and 4b) reflects the different direction of causality between the two variables. The interesting issue here is whether the increase in lending during periods of buoyant growth is excessive with respect to its macroeconomic and financial determinants and whether this is related to a credit tightening, which leads to a credit quality lowering and to a more than proportional increase of bad loans when the economic cycle reverts. The dynamic correlation analysis does not give a clear answer to this question. Therefore, further econometric analysis is carried out in the next section.

As regards the other macroeconomic and financial variables, the correlation signs between bad loans and industrial production, retail sales, consumer price index, housing price index, the 3-month Euribor rate, and the 10-year interest rate swap is mainly negative, as expected. The unemployment rate and the slope of the term structure are instead positively correlated.

[8] Foos, 2006; Guagliano and Lopez 2008.

[9] The ADF, PP and KPSS tests were conducted with the intercept and a deterministic linear trend specification for the levels, and with an intercept only for the logarithmic differences.

4. Empirical results

4.1 Macroeconomic and financial determinants of bad loans

Next we follow the approach of Kalirai and Scheicher (2002), Arpa et al. (2001), Shu (2002), and Bofondi and Ropele (2011), and run the following single equation regressions:

$$\Delta \log soff_t = \alpha + \sum_{i=1}^{p} \beta_i \Delta \log soff_{t\text{-}i} + \sum_{j=1}^{q} \gamma_{s,j} \Delta \log x_{s,t\text{-}j} + \varepsilon_t \qquad (1)$$

where α is the intercept, $soff_t$ and imp_t represent respectively bad loans and loans for all Italian banks (total bad loans and total loans, bad loans and loans to households and to firms) and for Cooperative Credit Banks, x_t is the set of macroeconomic and financial variables defined before, ε_t is the error term, and p and q are the lag order of the autoregressive component and of other regressors respectively.

The results from regression (1) are shown in the first columns on the left of Tables 5a – 5d together with the adjusted R^2. Although the autoregressive component is not always statistically significant, it is retained to avoid residual autocorrelation. The estimated coefficients for the variables related to the state of the economy (industrial production, unemployment and retail sales) are statistically significant and have the expected sign. Retail sales growth has a negative effect, but is statistically significant only in the equation for total bad loans and bad loans to firms of all banks. As highlighted in the empirical literature, macroeconomic shocks affect the ability of borrowers to repay debt with a time lag. Specifically, this is 7 – 9 quarters in the case of industrial production (2 for Cooperative Credit Banks), 9 in the case of unemployment (2 for Cooperative Credit Banks), and 2 in the case of retail sales.

Concerning the price stability variables, a negative sign is estimated for the consumer price index in the sample with all banks, and a positive but not statistically significant one in the sample with only the Cooperative Credit Banks. The time lag is always 1. As for the cost of debt variables (the 3-month Euribor interest rate and the 10-year IRS rate), their coefficients are statistically significant (though not in the equation for the CCBs) and negative, the time lag ranging from 1 to 2 months. The estimated relationship between real and financial wealth and loans is negative as expected, with a time lag from about 1 quarter to 1 year. Finally, contrary to what was expected, bad loans are positive related to the slope of the interest rate curve.

The next step is the estimation of equations including all the variables found to be statically significant in the first stage, and eliminating those with multicollinearity problems. Equation (1) can be rewritten as follows:

$$\Delta \log soff_t = \alpha + \sum_{i=1}^{p} \beta_i \Delta \log soff_{t-i} + \sum_{j=1}^{q} \gamma_{s,j} \rho_s \Delta \log x_{t-j} + \sum_{m=1}^{M} \delta_m dummy_{m,t} + \varepsilon_t \quad (2)$$

where ρ_s is a binary variable (equal to 0 for the macroeconomic and financial variables that are insignificant or affected by multicollinearity problems, equal to 1 otherwise) and $dummy_t$ is a set of dummy variables different for each equation. In particular, dummies were introduced in the bad loans equations in May 2001 and December 2005 for the equations with all banks (see Table 5a – 5c), and in July 2002 for the Cooperative Credit Banks (see Table 5d) in order to model the anomalies related to the securitisations already mentioned in Section 3. Other variables fond to be statistically significant in the first step are excluded ($\rho_s = 0$) on the basis of the Akaike and Schwarz information criteria and sign coherence.

The results presented in the RHS columns of Tables 5a – 5d confirm the statistical significance and consistence with economic theory of the estimated coefficients for economic growth (in particular those on the unemployment rate and the consumer price index, though not in the equation for total bad loans of all banks, while that on the retail sales index has low significance), real and financial wealth (that on the housing price only in the equation for bad loans to households and that on the FTSE Mib stock exchange index only in the equation for bad loans to firms) and cost of debt (the 3-month Euribor rate). The estimates for Cooperative Credit Bank bad loans indicate that these are affected by the state of the economy (industrial production, unemployment and consumer price index) and financial wealth (FTSE Mib stock exchange index) but not by the cost of debt. To sum up, bad loans of all banks are in general mainly affected, with a time lag, by the cost of debt, the state of the economy variables and real and financial wealth, while those of the Cooperative Credit Banks by economic growth and real wealth.

The estimated equations (2) presented in Tables 5a – 5d explain well bad loans, as indicated by the adjusted R^2, with values between 0.7 and 0.85.

4.2 Bad loans surplus during recessions

Having established the robustness of the econometric specification for bad loans (2), we now examine whether (i) there is an excess of bad loans during the contractionary phases of the economic cycle and whether (ii) this is a consequence of the excessive credit provided during the previous expansionary phases.

To address (i) we test for the existence of an excess of bad loans during the 2008-2009 and 2011-2012 periods of turmoil. Here an excess of bad loans (or a bad loan surplus) is defined as a level of bad loans greater than that which could be explained only by the deterioration of the

macroeconomic situation. The existence of such a surplus during recessions could be related to excess lending (due to a bad selection criteria) in the past.

A good proxy of the bad loan component not explained by its macroeconomic and financial determinants is given by the regressions residuals of equation (2). These can be assumed to follow a standardised normal distribution. Therefore, we cannot reject the null hypothesis of the existence of a "bad loan surplus" when the cumulative function of the residuals is persistently above 1.96 standard errors (equal to 1.96 in the case of a normal distribution), i.e. for at least two months.

Figures 4a – 4d report the cumulative function of the residuals from equations (2), providing support to the existence of a bad loan surplus after the recession of 2008-2009 for total bad loans and bad loans to firms, only slightly for the Cooperative Credit Banks, and not in the case of bad loans to households of all banks. Point (ii) is examined in the next sub-section using VAR techniques.

4.3 Is the bad loan surplus affected by past lending policies? A B–Q SVAR approach

We test whether the bad loan surplus is a consequence of excessive loans granted in previous periods using the Blanchard and Quah (1989) method. This allows us to identify a sequence of temporary and permanent shocks from loans to bad loans using a bivariate structural VAR (Vector Autoregressive).

Consider the following moving average (MA) representation of infinite order

$$Z_t = \Phi(L)\varepsilon_t \tag{3}$$

$$\begin{bmatrix} \Delta \log soff_t \\ \Delta \log imp_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{Tt} \\ \varepsilon_{Pt} \end{bmatrix} \tag{4}$$

where, as above, $soff_t$ and imp_t are bad loans and loans of all banks respectively, while the parameters ε_{Tt} and ε_{Pt} represent permanent and transitory shocks generated at time *t*. It is assumed that the innovations ε_{Tt} and ε_{Pt} are independently distributed with zero mean and constant variance. This representation has also been adopted for bad loans to households and to firms of all banks and for the sub-sample of the Cooperative Credit Banks.

$$\begin{bmatrix} \Delta \log sof\_bcc_t \\ \Delta \log imp\_bcc_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{Tt} \\ \varepsilon_{Pt} \end{bmatrix} \tag{5}$$

In addition, a restriction is imposed such that temporary shocks ε_{Tt} should not affect bad loans in the long term, by defining in equation (5) the cumulative effect of the ε_{Tt} shocks on bad loans according to the following condition:

$$\upsilon'\Phi(1)\upsilon = 0 \tag{6}$$

where $\upsilon = (1,0)'$.

This implies that the sum of the effects of temporary shocks on bad loans must be equal to zero. Moreover, since $\Delta \log imp_t$, $\Delta \log soff_t$, $\Delta \log soff\_bcc_t$ and $\Delta \log imp\_bcc_t$ are stationary and the variables $soff_t$ and imp_t, $soff\_bcc_t$ and imp_bcc_t are not cointegrated in levels (as shown by the cointegration tests reported in Table 6), the residuals can be represented in the following autoregressive form:

$$\Phi^{-1}(L)Z_t = \varepsilon_t \tag{7}$$

It follows that it is possible to estimate a finite order VAR for the equation (7), which generates a vector of e_t innovations with a variance matrix equal to Σ, such that

$$e_t = \left[1 - \Theta(L)\right] Z_t \tag{8}$$

where $\Theta(L)$ is a polynomial of finite order in the lag operator. It can be shown that the VAR residuals are a linear combination of temporary and permanent shocks:

$$\varepsilon_t = Ce_t \tag{9}$$

where C is a (2x2) size matrix. If all four elements of the matrix C are known, it is possible to obtain ε_t from the VAR residuals e_t. However, to identify the elements of the C matrix four restrictions are needed, three of which can be obtained by normalising to one the innovations of a moving average representation and assuming its orthogonality, i.e.

$$CC' = \Sigma \tag{10}$$

Substituting (8) into (7) then gives:

$$D = \Phi(1) \tag{11}$$

where $D = [1 - \Theta^{-1}(1)]C^{-1}$. The fourth restriction can derived using jointly equations (9) and (13):

$$\upsilon' D \upsilon = 0 \tag{12}$$

Using the restrictions given by (10) and (12) we are able to identify all four elements of the C matrix, while the full sequence of temporary and permanent disturbances can be obtained from (9). The permanent loan shock can be interpreted as a supply shock, or the loan component not due to credit demand, but to an excessive decrease (increase) of credit during persistently positive (negative) phases of the business cycle. Similarly, the permanent bad loans shock can be thought of

as the bad loan surplus with respect to the economic conditions during the recessions of 2008 – 2009 and 2011 – 2012 (Figure 4a – 4d).

As a first step, the lag order for all SVARs is set equal to 6 on the basis of standard information criteria. Cointegration tests rule out the existence of cointegration vectors among the variables included in the SVARs (see Table 6). Finally, all diagnostic tests confirm that the bivariate VARs are correctly specified (see Table 7).

Figures 5a – 5d display the impulse responses. A permanent shock of 1% to the loan residuals (i.e. their component not explained by economic fluctuations) leads to an increase of over 50% of total bad loans of all Italian banks (Figure 5a) and it takes about 14 (24) months for the effects of the shock to fall below 10% (5%). The effect is higher (around 70%) and more persistent (36 months to be under the threshold of 10%) for bad loans to firms (Figure 5b), while is not significantly different from zero for bad loans to households (Figure 5c). In the case of the Cooperative Credit Banks (Figure 5d), the initial effect, always positive, is much lower (34.8%) than for all Italian banks, but persistent: it takes 16 (26) months for it to fall below 10% (5%).

In brief, the impulse response analysis suggests that bad loans have a positive and statistically significant effect on bad loans of the Italian banking system (with the exclusion of bad loans to households), with high persistence (about two years). This positive and persistent effect implies that the bad loan surplus during the recessions of 2008 – 2009 and 2011 – 2012 was affected by the lending policies of Italian banks in the previous periods. In other words, in addition to the deterioration of economic conditions excessive credit in the years before the recessions also played a role. Further, the results for the Cooperative Credit Banks confirm that they can select local creditworthy borrowers more accurately (Berger and Udell, 2002), because of peer monitoring of members (Stiglitz, 1990) and harder incentives for borrowers to repay funds (Angelini, Di Salvo and Ferri 1998; Banerjee et al., 1994; Chaddad and Cook, 2004; Hesse and Čihák, 2007). This is confirmed also by the forecast variance decomposition analysis in Figures 6a – 6d. In particular, Figure 6a shows that between 30 and 33 percent of the variability of bad loans over a period of 36 months (3 years) is explained by a permanent shock to loans (between 62 and 54 per cent for loans to firms and between 3 and 5 percent for loans to households – see Figure 6b and 6c). On average, the variance component of bad loans for the banking system explained by a permanent shock to loans over a business cycle is equal to 32.24% (55.71% for loans to firms and 4.80% for loans to households). For the Cooperative Credit Banks (Figure 6d), the corresponding percentage is equal, on average, to 17.24%.

Finally, Granger causality tests (Table 8) provides further empirical confirmation that lagged loans contain useful information to predict total bad loans and bad loans to firms of all banks and total bad loans of Cooperative Credit Banks.

5. Conclusions

The empirical literature on the relationship between credit quality in the banking sector and macroeconomic cycles has emphasised that the former is affected by negative macroeconomic and financial shocks (see Bofondi and Ropele, 2011). On the other hand, it is well known that bank loans are pro-cyclical, and therefore loans and credit quality are inversely related to the business cycle. Loans increase rapidly in periods of growth and tend to stabilise or even contract during recessions. Bad loans, considered as a measure of credit quality, are relatively stable during periods of strong economic growth, and then they grow exponentially during recessions. An issue of considerable interest is whether, given this inverse relationship with the economic cycle, an excess of credit during periods of economic growth can cause an excess of bad loans when the economy contracts.

This paper has aimed to answer this question, first identifying the macroeconomic determinants of bad loans and loans, then analysing empirically the existence of an excess of bad loans during the recession of 2008-2012 and, finally, testing the effects of a permanent shock to bad loans on the excess of credit with a bivariate structural VAR à la Blanchard and Quah (1989). The results indicate that, for the banking sector as a whole, these are significant and persistent for bad loans to firms but not for bad loans to households.

Moreover, in the case of Cooperative Credit Banks, that are mostly small local banks adopting a relationship banking approach with credit borrowers (Berger and Udell, 2002), there is no evidence of such a bad loans surplus. Their lending policies are more efficient than those of other banks and do not lead to excessive bad loans during recessions.

References

[1] AGRESTI A. M. – P. BAUDINO – P. PAOLONI (2008), "The ECB and IMF indicators for the macroprudential analysis of the banking sector: a comparison of the two approaches", *ECB Occasional Paper* n. 99.

[2] ANGELINI P. – R. DI SALVO – G. FERRI (1998), "Availability and cost of credit for small businesses: customer relationships and credit cooperatives", *Journal of Banking and Finance*, vol. 22, pp. 925-954.

[3] ARPA M. – A. GIULINI – A. ITTNER – F. PAUER (2001), "The influence of macroeconomic developments on Austrian banks: implications for banking supervision", *BIS Paper* n. 1, pp. 91-116.

[4] BABOUCEK I. – M. JANCAR (2005), "Effects of macroeconomic shock to the quality of the aggregate loan portfolio", *Czech National Bank, Working Paper Series*, n. 1, pp. 1-62.

[5] BANERJE A. V. – T. BESLEY – T. BESLEY (1994), "Thy neighbor's keeper: the design of a credit cooperative with theory and a test", *Quarterly Journal of Economics*, vol. 109, pp. 491-515.

[6] BERGER A. N. – G. F. UDELL (2002), "Small business credit availability and relationship lending: the importance of bank organisational structure", *The Economic Journal*, vol. 112, F32-F53.

[7] BERK J. M. – J. A. BIKKER (1995), "International interdependence of busyness cycles in manufacturing industry", *Journal of Forecasting*, vol. 14, pp. 1-23.

[8] BIKKER J. A. – H. HU (2002), "Cyclical patterns in profits, provisioning and lending of banks and procyclicality of the new Basel capital requirements", *BNL Quarterly Review* , vol. 55, pp. 143-75.

[9] BIKKER J. A. – P. A. METZEMAKERS (2005), "Bank provisioning behaviour and prociclicality", *Research Series Supervision*, n. 50, pp. 1-21.

[10] BLANCHARD O. – D. QUAH (1989), "The dynamic effects of aggregate demand and supply disturbances", *American Economic Review*, vol. 79, pp. 655-73.

[11] BOESCHOTEN W. C. – P. J. A. VAN ELS – J. A. BIKKER (1994), "Monetary transmission in a small open economy: the case of the Netherlands", *Nederlansche Bank Research Memorandum*, n. 406.

[12] BOFONDI M. – T. ROPELE (2011), "Macroeconomic determinants of bad loans: evidence from Italian banks", *Questioni di Economia e Finanza (Occasional Papers) della Banca d'Italia*, n. 89, Marzo.

[13] CHADDAD F. – M. COOK (2004), "Understanding new cooperative models: an ownership-control rights typology", *Review of Agricultural Economics*, vol. 26, pp. 348-360.

[14] DE LONG J. B. – L. H. SUMMERS (1991), "Equipment investment and economic growth", *Quarterly Journal of Economics*, vol. 106, pp. 445-502.

[15] DEMIRGUC – KUNT A. – E. DETRAGIACHE (1998), "The determinants of banking crises in developing and developed countries", *IMF Staff Papers*, vol. 45 (n. 1), pp. 81-109.

[16] DICKEY D. A. – W. A. FULLER (1979), "Distribution of the estimators for autoregressive time series with a unit root", *Journal of the American Statistical Association*, vol. 74, pp. 427-431.

[17] DI COLLI S. – A. GIRARDI (2011), "Restrizione creditizia durante la crisi del 2007 -2009 e il ruolo anticiclico delle Banche di Credito Cooperativo", *mimeo*.

[18] DI GIULIO D. (2009), "Finanziamenti bancari al settore produttivo: credit crunch o extra-credito", *Temi di Economia e Finanza*, ABI, Novembre, n.1

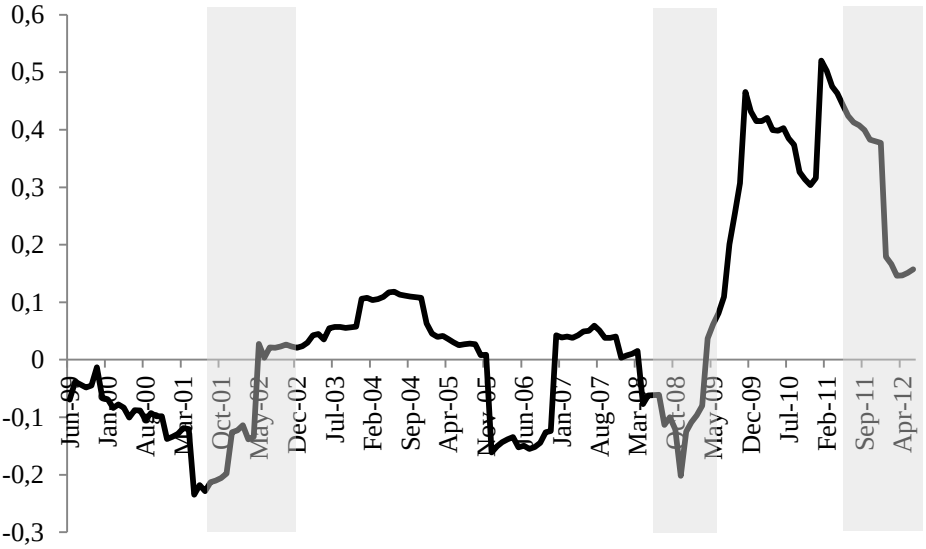
[19] ESTRELLA A. – G. HARDOUVELIS (1991), "The term structure as a predictor of real economic activity", *Journal of Finance*, vol. 46, pp. 555-576.

[20] ESTRELLA A. – F. S. MISHKIN (1998), "Predicting US recessions: financial variables as leading indicators", *Review of Economics and Statistics*, vol. 80, pp. 45-61.

[21] FAMA E. F. (1984), "The information in the term structure", *Journal of Financial Economics*, vol. 13, pp. 509 - 528.
[22] FILOSA R. (2007), "Stress testing of the stability of the Italian banking system: a VAR approach", *Heterogeneity and Monetary Policy*, n. 703, pp. 1 – 46.
[23] FOOS D. (2009), "Lending conditions, macroeconomic fluctuations and the impact of bank ownership", *working paper available at* http://www-wiwi.uni-muenster.de/fcm/downloads/forschen/ifk_bankenworkshop/Foos_LendingMacroOwnership_200904.pdf .
[24] GAMBERA M. (2000), "Simple forecasts of bank loan in the business cycle", *Emerging Issues Series*, vol. 3, pp. 1 - 27.
[25] GAVIN M. – R. HAUSMAN (1996), "The roots of banking crises: the macroeconomic context", *Inter-American Bank, Working Paper* n. 318, pp. 1-20.
[26] GRANGER C. W. J. – P. NEWBOLD (1974), "Spurious regressions in econometrics", *Journal of Econometrics*, vol. 2, pp. 111-120.
[27] GUAGLIANO C. – J. S. LOPEZ (2008), "Nella buona e nella cattiva sorte… Ovvero banche locali e territorio: un matrimonio non solo di interesse", *Cooperazione di credito*, vol. 199, pp. 65-80.
[28] HARDY D. – C. PAZARBAŞIOĞLU (1998), "Leading indicators of banking crisis: was Asia different?", *IMF Working Papers*, n. 98/91, pp. 31-32.
[29] HESSE H. – M. ČIHÁK (2007), "Cooperative banks and financial stability", *IMF working paper*, WP/07/2.
[30] HOGGART G. – S. SORENSEN – L. ZICCHINO (2005), "Stress tests of UK banks using a VAR approach", *Bank of England Working Papers*, n. 282.
[31] JIMENEZ G. – J. SAURINA (2006), "Credit cycles, credit risk and financial regulation", *International Journal of Central Banking*, vol. 2, pp. 65-98.
[32] KALIRAI H. – M. SCHEICHER (2002), "Macroeconomic stress testing: preliminary evidence for Austria", *Austrian National Bank Financial Stability Report*, Maggio, n. 3.
[33] KEETON W. R. (1999), "Does faster loan growth lead to higher loan losses?", *Federal Reserve Bank of Kansas City Economic Review*, 84, pp. 57-75.
[34] KEETON W. R. – C. S. MORRIS (1987), "Why do banks's loan losses differ?", Federal Reserve Bank of Kansas City, *Economic Review*, Maggio.
[35] MANKIW N. G. – A. J. MIRON (1986), "The changing behaviour of the term structure of interest rates", *Quarterly Journal of Economics*, vol. 101, pp. 211-228.
[36] MARCUCCI J. – M. QUAGLIARELLO (2008), "Is bank portfolio risk procyclical? Evidence from Italy using a Vector Autoregression", *Journal of International Financial Markets, Institutions and Money*, vol. 18, pp. 46-63.
[37] PANETTA F. – F. M. SIGNORETTI (2010), "Domanda e offerta di credito in Italia durante la crisi finanziaria", *Questioni di Economia e Finanza*, n. 63, Banca d'Italia, aprile.
[38] PAOLAZZI L. – C. RAPACCIUOLO (2009), "C'è un credit crunch in Eurolandia e in Italia?", *Nota dal Centro Studi Confindustria*, n. 09-04, Confindustria, Novembre.
[39] PHILLIPS P. C. B. – PERRON P. (1988), "Testing for a Unit Root in Time Series Regression", *Biometrika*, vol. 75, pp. 335–346.
[40] QUAGLIERIELLO M. (2007), "Bank riskiness over the business cycle: a panel data analysis on Italian intermediaries", *Applied Financial Economics*, vol. 17, pp. 119-38.
[41] RINALDI L. – A. SANCHIS-ARELLANO (2006), "Household debt sustainability: what explains household non-performing loans? An empirical analysis", *ECB Working Paper*, n. 570.
[42] SHU C. (2002), "The impact of macroeconomic environment of the asset quality of Hong Kong's banking sector", *Hong Kong Monetary Authority Research Memorandums.*
[43] STIGLITZ J. E. (1990), "Peer monitoring and credit markets", *World Bank Economic review*, vol. 4, pp. 351-366.

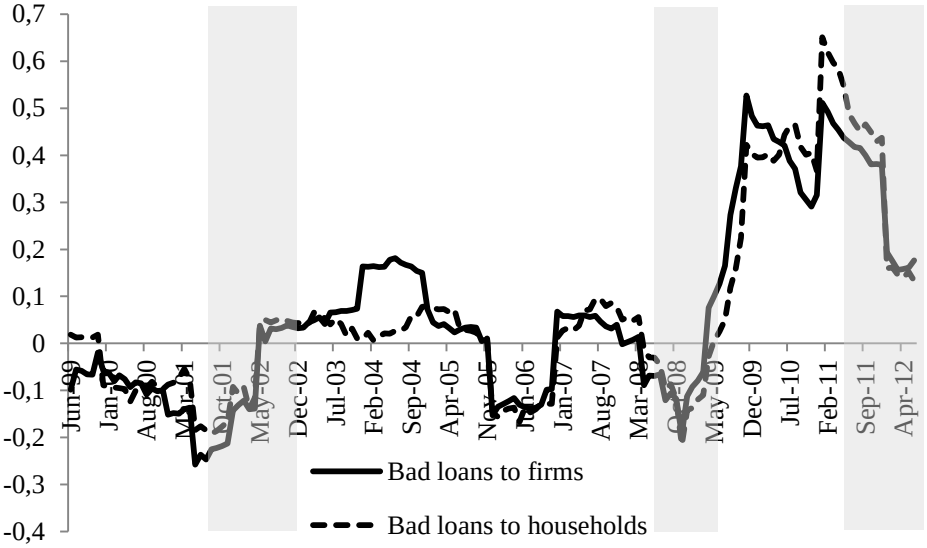
Figures

Figure 1a. *Total bad loans of the Italian banking system*



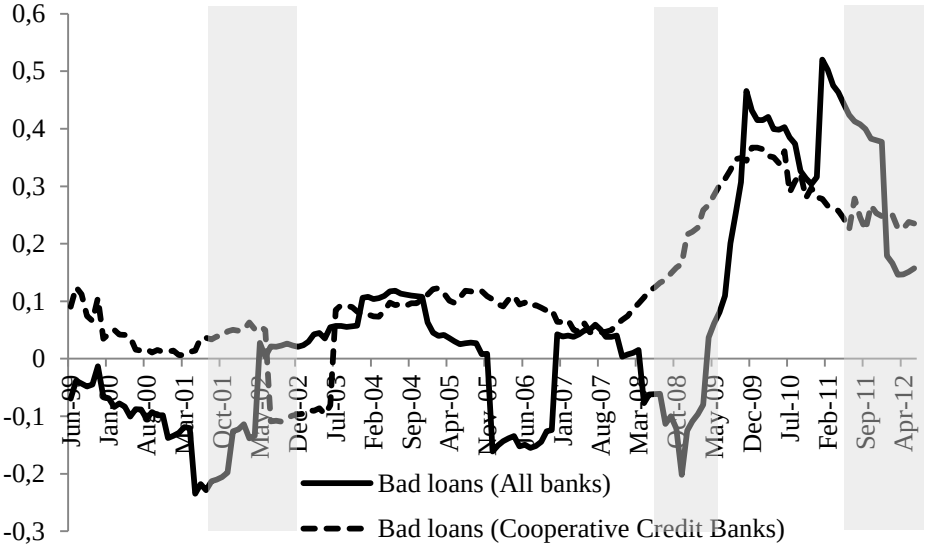
Note. Total bad loans (logarithmic difference year over year) for the Italian banking system from June 1999 to December 2012. The grey areas indicate the Italian economic recessions of 2001-2002, 2008-2009 and 2011-2012. Descriptive statistics for this variable are provided in Table 2.
Source (see also Table 1): Bank of Italy.

Figure 1b. *Total bad loans to firms and to households*



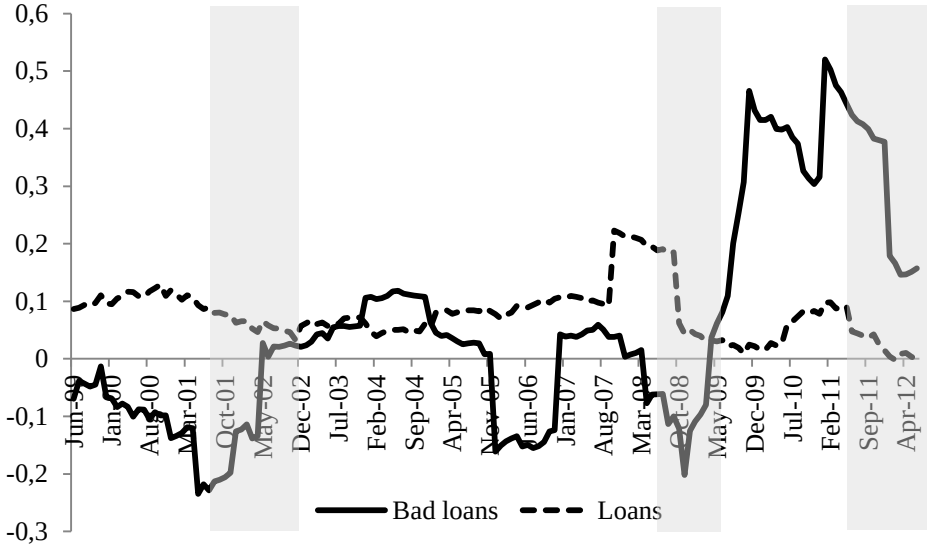
Note. Total bad loans to firms (logarithmic difference year over year) and to households (logarithmic difference year over year) for the Italian banking system from June 1999 to December 2012. The grey areas indicate the Italian economic recessions of 2001-2002, 2008-2009 and 2011-2012. Descriptive statistics for this variable are provided in Table 2.
Source (see also Table 1): Bank of Italy.

Figure 1c. *Total bad loans - All banks and Cooperative Credit Banks*



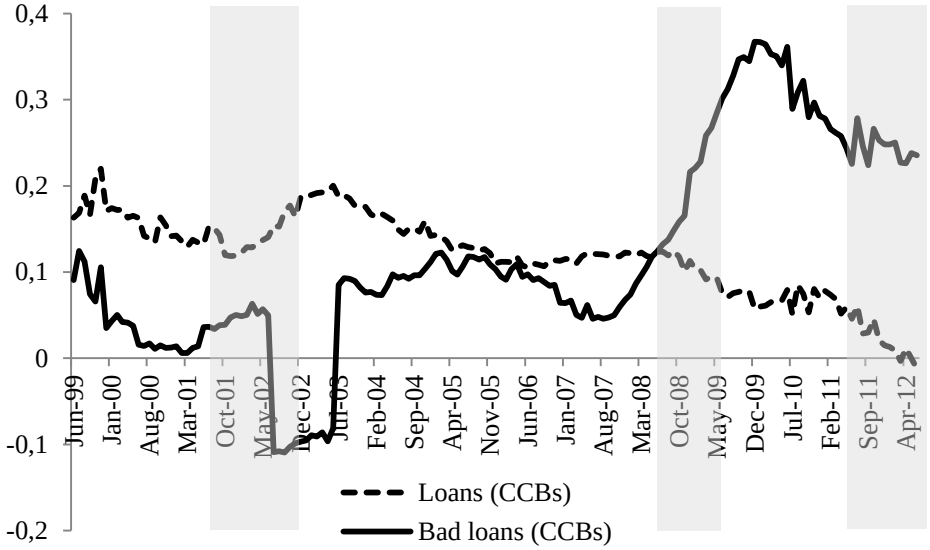
Note. Total bad loans (logarithmic difference year over year) of all banks and only Cooperative Credit Banks (BCCs) for Italian banking system from June 1999 to December 2012. The grey areas indicate the Italian economic recessions of 2001-2002, 2008-2009 and 2011-2012. Descriptive statistics for this variable are provided in Table 2.
Source (see also Table 1): Bank of Italy.

Figure 2a. *Total bad loans and total loans (without bad loans) – All banks*



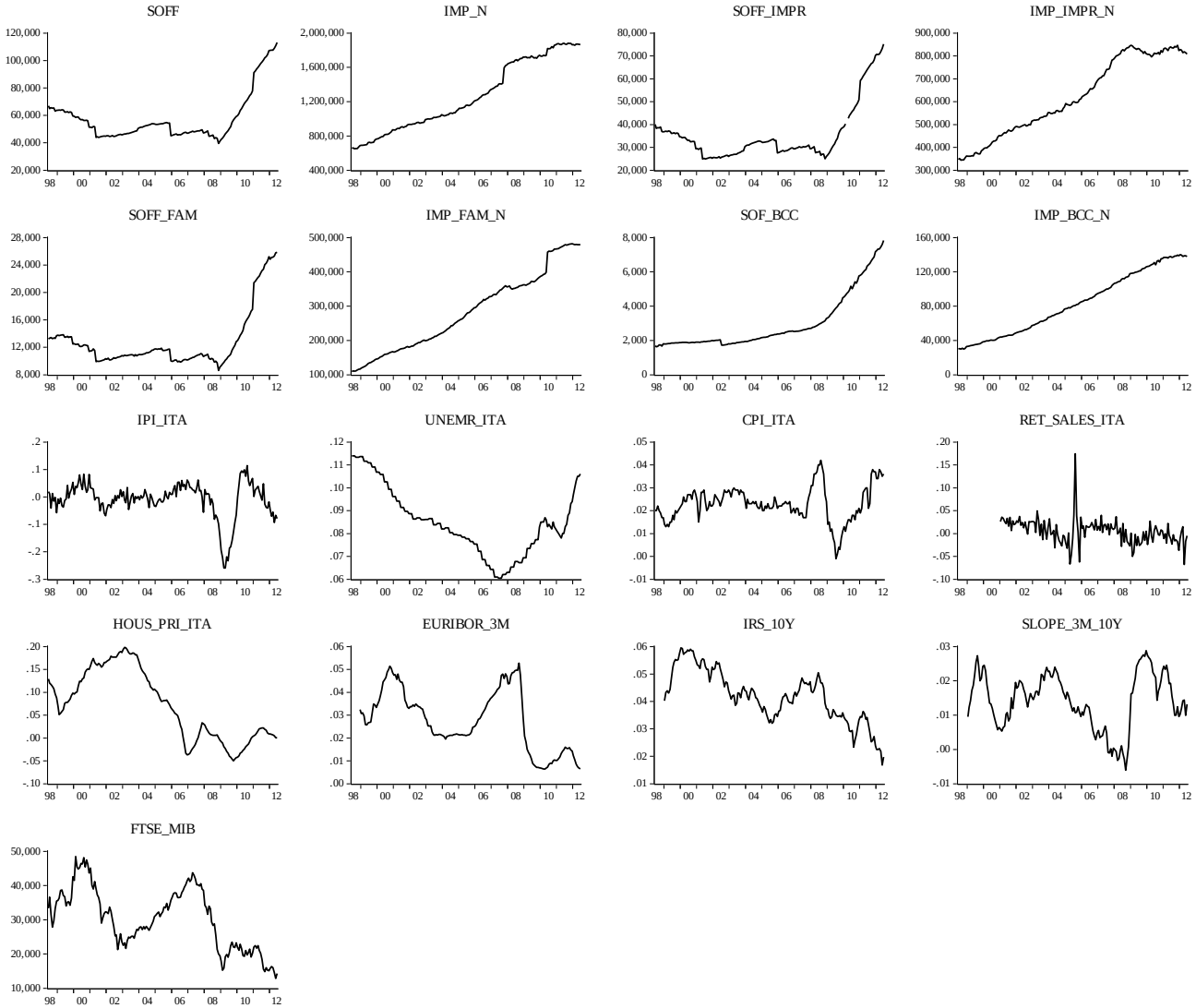
Note. Total bad loans (logarithmic difference year over year) and total loans (minus bad loans, logarithmic difference year over year) for Italian banking system from June 1999 to December 2012. The grey areas indicate the Italian economic recessions of 2001-2002, 2008-2009 and 2011-2012. Descriptive statistics for this variable are provided in Table 2.
Source (see also Table 1): Bank of Italy.

Figure 2b. *Bad loans and total loans (without bad loans) – Cooperative Credit Banks % ch. y/y*



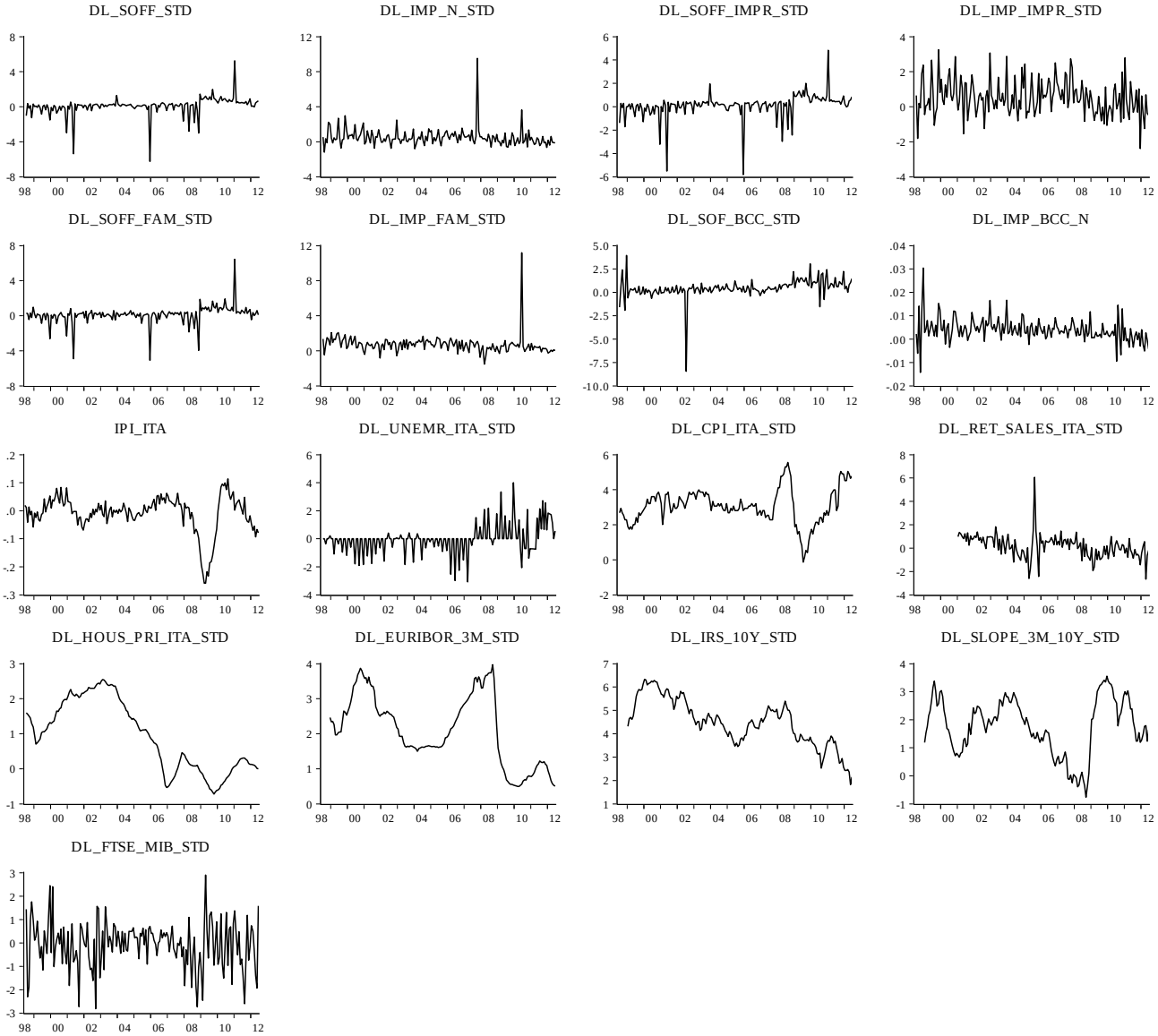
Note. Total bad loans (logarithmic difference year over year) and total loans (minus bad loans, logarithmic difference year over year) for Italian Cooperative Credit Banks from June 1999 to December 2012. The grey areas indicate the Italian economic recessions of 2001-2002, 2008-2009 and 2011-2012. Descriptive statistics for this variable are provided in Table 2.
Source (see also Table 1): Bank of Italy.

Figure 3a. *Raw series*



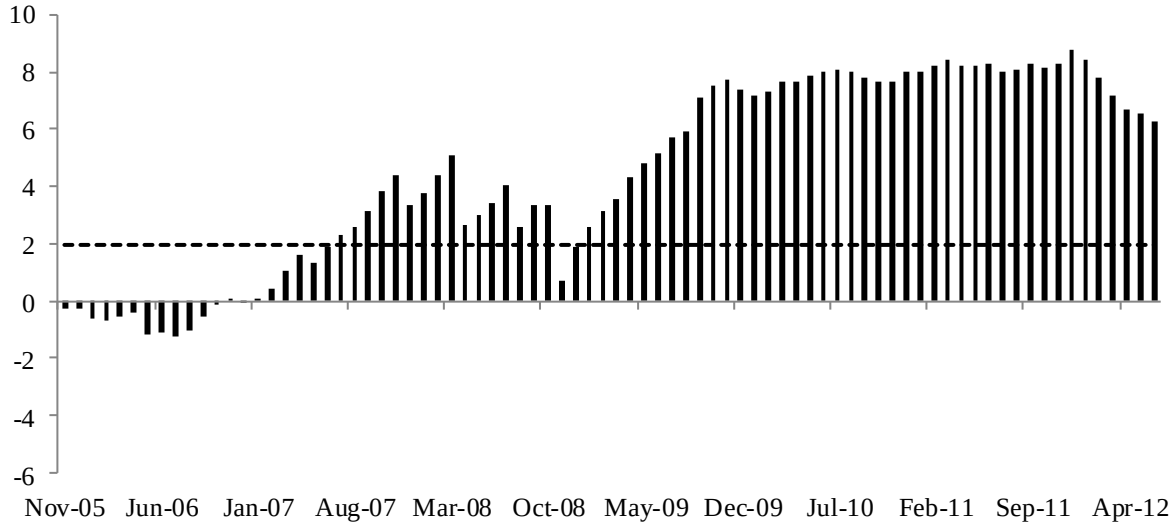
Acronyms: SOFF = Total bad loans of Italian banking system (in million euros), IMP = Total loans of Italian banking system without bad loans (in million euros), SOFF_BCC = Total bad loans of Cooperative Credit Banks (in million euros), IMP_BCC = Total loans of Cooperative Credit Banks (in million euros), IPI_ITA = Italian Industrial Production Index rate of change year over year, CPI_ITA = Italian Consumer Price Index rate of change year over year, UNEMR_ITA = Italian unemployment rate (in percentage points), RET_SALES_ITA = Italian Retail Sales Index rate of change year over year, HOUS_PRI_ITA = Italian Housing Price Index rate of change year over year, EURIBOR_3M = Euribor 3 Month Interest Rate, IRS_10Y = Interest Rate Swap 10 Years, SLOPE_3M_10Y = Difference between Interest Rate Swap 10 Years and Euribor 3 Month Interest Rate, FTSE_MIB = FTSE Mib Stock Exchange Index.
Sources: see Table 1.
Descriptive Statistics: see Table 2.

Figure 3b. *Standardised series in logs*



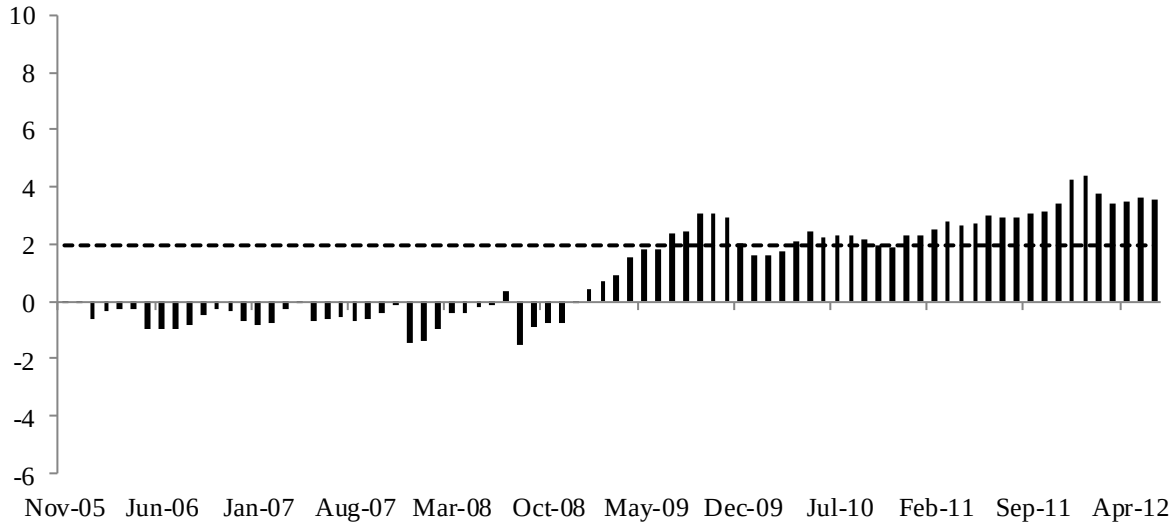
Acronyms. DL_SOFF_STD = Logarithmic first difference of total bad loans of Italian banking system (in million euros), DL_IMP_N_STD = Logarithmic first difference of total loans of Italian banking system without bad loans (in million euros), DL_SOFF_BCC_STD = Logarithmic first difference of total bad loans of Cooperative Credit Banks (in million euros), DL_IMP_BCC_N_TSD = Logarithmic first difference of total loans of Cooperative Credit Banks (in million euros), IPI_ITA = Italian Industrial Production Index rate of change year over year, DL_UNEMR_ITA_STD = Logarithmic first difference of Italian unemployment rate (in percentage points), DL_CPI_ITA_STD = Italian Consumer Price Index rate of change year over year, DL_RET_SALES_ITA_STD = Logarithmic first difference of Italian Retail Sales Index rate of change year over year, DL_HOUS_PRI_ITA_STD = Logarithmic first difference of Italian Housing Price Index rate of change year over year, DL_EURIBOR_3M_STD = Logarithmic first difference of Euribor 3 Month Interest Rate, DL_IRS_10Y_STD = Logarithmic first difference of Interest Rate Swap 10 Years, DL_SLOPE_3M_10Y_STD = Logarithmic first difference of Interest Rate Swap 10 Years - Euribor 3 Month Interest Rate, DL_FTSE_MIB_STD = Logarithmic first difference of FTSE Mib Stock Exchange Index.
Sources: see Table 1.
Descriptive Statistics: see Table 2

Figure 4a. *Surplus of bad loans (Italian Banks) wrt their macroeconomic determinants*



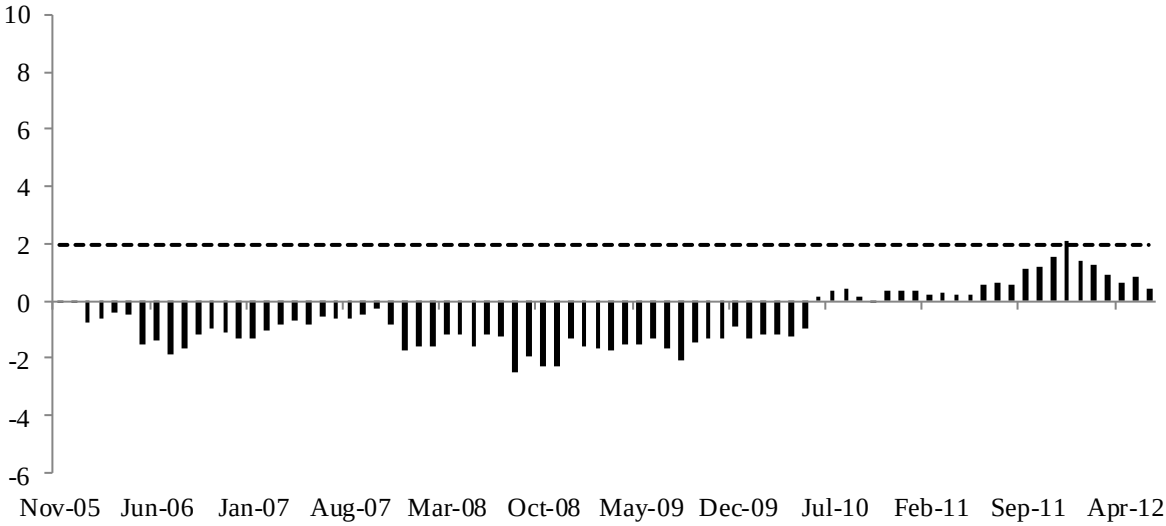
Note. Bad loan surplus with respect to their macroeconomic fundamentals is the cumulated function of residuals for the equation (1), where the dependent variable is total bad loans for Italian banking system regressed on its macroeconomic and financial determinants. Under the assumption of normality in the residuals, the existence of a bad loan surplus is considered statistically significant when the cumulated function of residuals is persistently (at least two months) above 1.96.

Figure 4b. *Surplus of bad loans to firms (Italian Banks) wrt their macroeconomic determinants*



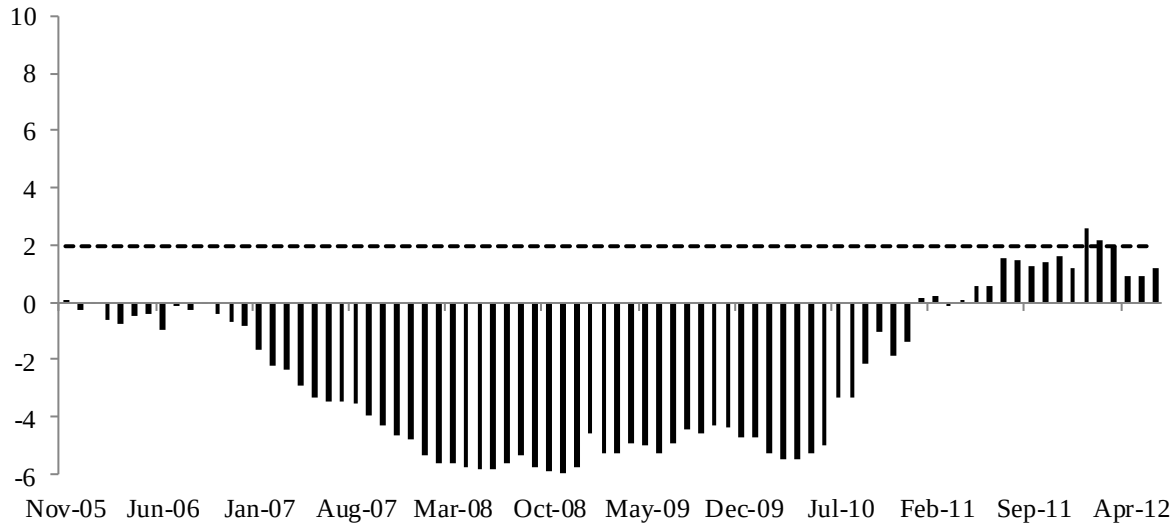
Note. Surplus of bad loans to firms with respect to their macroeconomic fundamentals is the cumulated function of residuals for the equation (1), where the dependent variable is total bad loans for Italian banking system regressed on its macroeconomic and financial determinants. Under the assumption of normality in the residuals, the existence of a bad loan surplus is considered statistically significant when the cumulated function of residuals is persistently (at least two months) above 1.96.

Figure 4c. *Surplus of bad loans to households (Italian Banks) wrt their macroeconomic determinants*



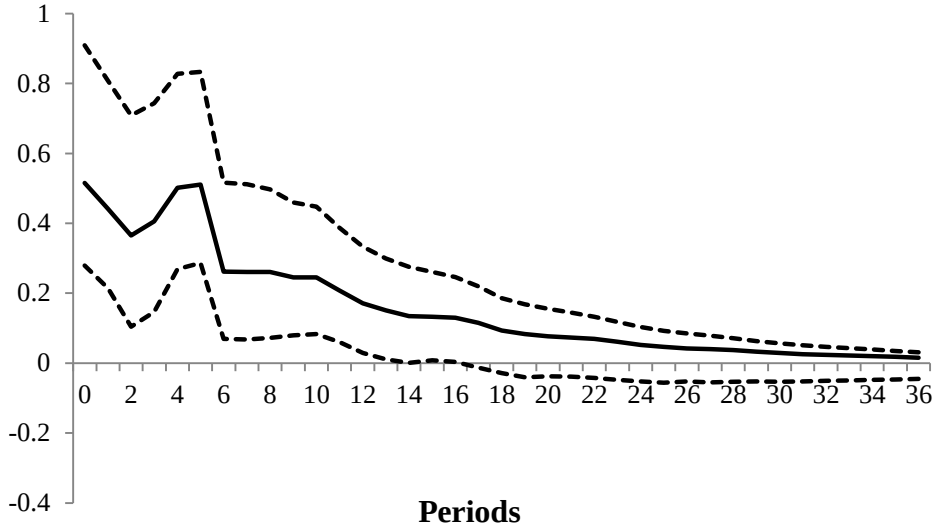
Note. Surplus of bad loans to households with respect to their macroeconomic fundamentals is the cumulated function of residuals for the equation (1), where the dependent variable is total bad loans for Italian banking system regressed on its macroeconomic and financial determinants. Under the assumption of normality in the residuals, the existence of a bad loan surplus is considered statistically significant when the cumulated function of residuals is persistently (at least two months) above 1.96.

Figure 4d. *Surplus of bad loans (Italian Cooperative Credit Banks) wrt their macroeconomic determinants*



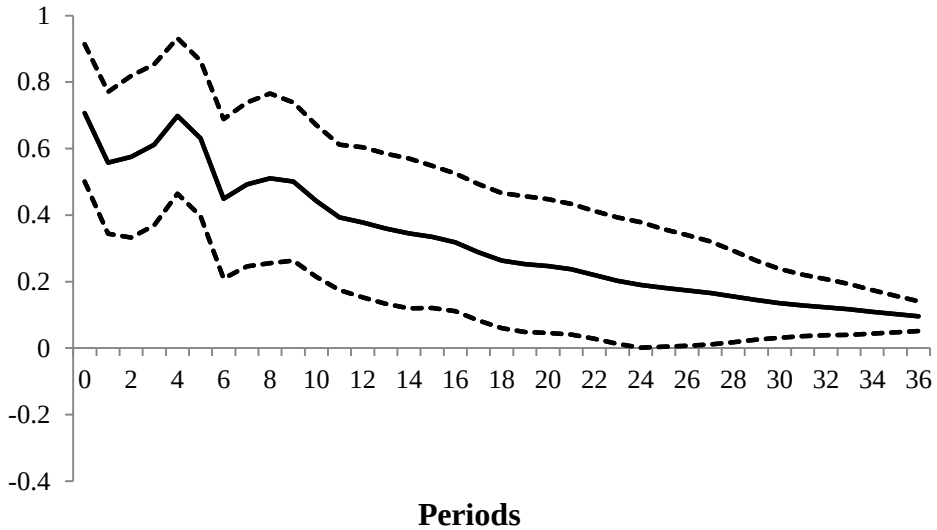
Note. Surplus of Cooperative Credit Bank bad loans with respect to their macroeconomic fundamentals is the cumulated function of residuals for the equation (1), where the dependent variable is total bad loans for Italian banking system regressed on its macroeconomic and financial determinants. Under the assumption of normality in the residuals, the existence of a bad loan surplus is considered statistically significant when the cumulated function of residuals is persistently (at least two months) above 1.96.

Figure 5a. *Impulse Response Analysis from total loans to total bad loans of all banks*



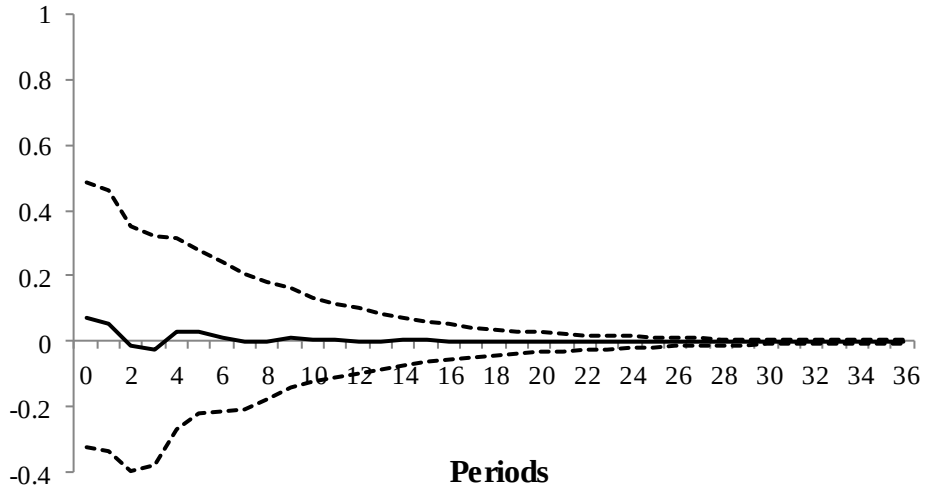
Note. Impulse response analysis on the basis of (3) – (12) B–Q SVAR estimations. The impulse in this figure is from total loans residuals to total bad loans of all Italian banks.

Figure 5b. *Impulse Response Analysis from loans to firms to bad loans to firms of all banks*



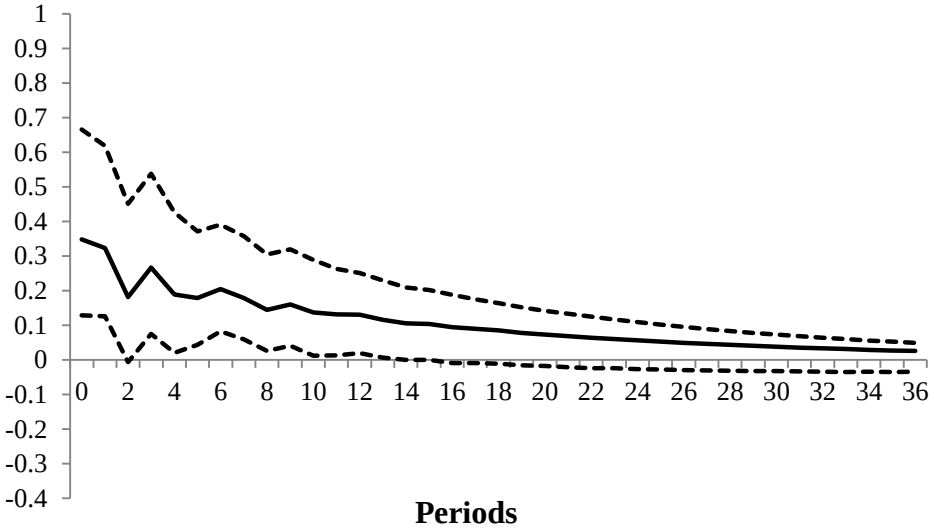
Note. Impulse response analysis on the basis of (3) – (12) B–Q SVAR estimations. The impulse in this figure is from loans to firms residuals to bad loans to firms of all Italian banks.

Figure 5c. *Impulse Response Analysis from loans to households to bad loans to households of all banks*



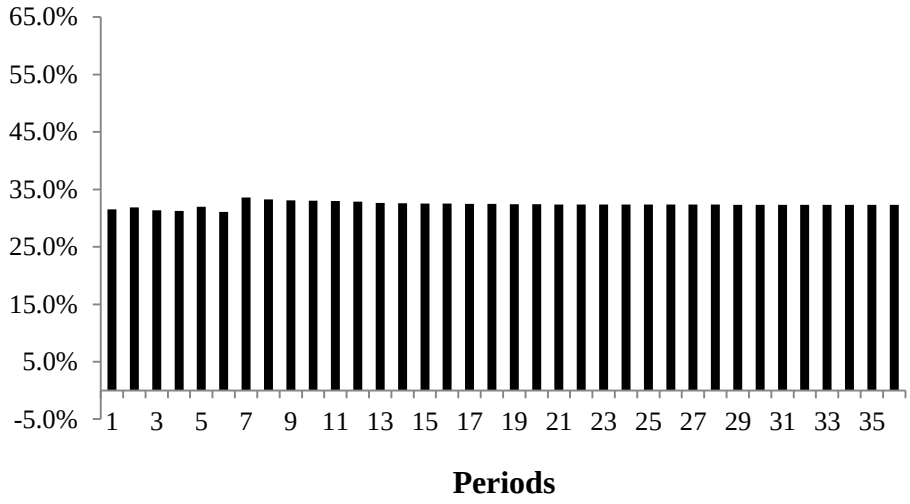
Note. Impulse response analysis on the basis of (3) – (12) B–Q SVAR estimations.The iImpulse in this figure is from loans to households residuals to bad loans to households of all Italian banks.

Figure 5d. *Impulse Response Analysis from total loans to total bad loans of Cooperative Credit Banks*



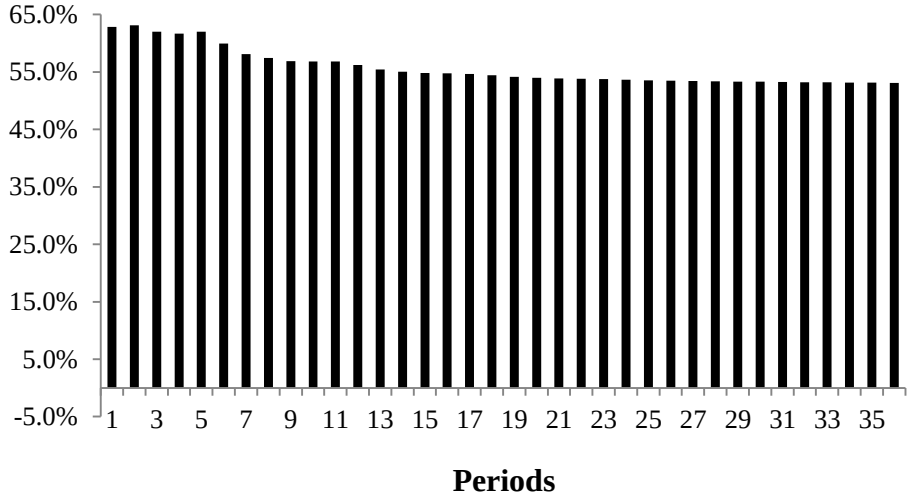
Note. Impulse response analysis on the basis of (3) – (12) B–Q SVAR estimations. The impulse in this figure is from total loans residuals to total bad loans of Italian Cooperative Credit Banks.

Figure 6a. *Variance decomposition (total loans to total bad loans of all banks)*



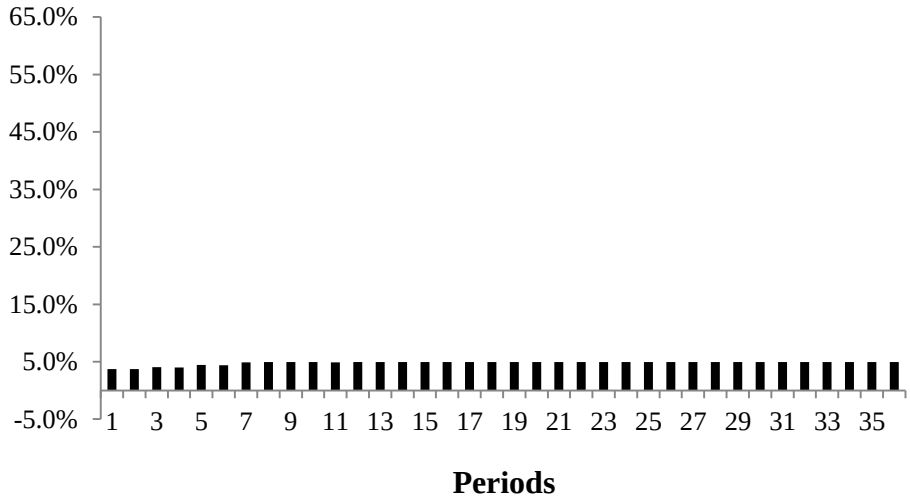
Note. Variance decomposition analysis on the basis of (3) – (12) B–Q SVAR estimations showing the percentage of variance of total bad loans explained by total loans of all Italian banks.

Figure 6b. *Variance decomposition (loans to firms to bad loans to firms of all banks)*



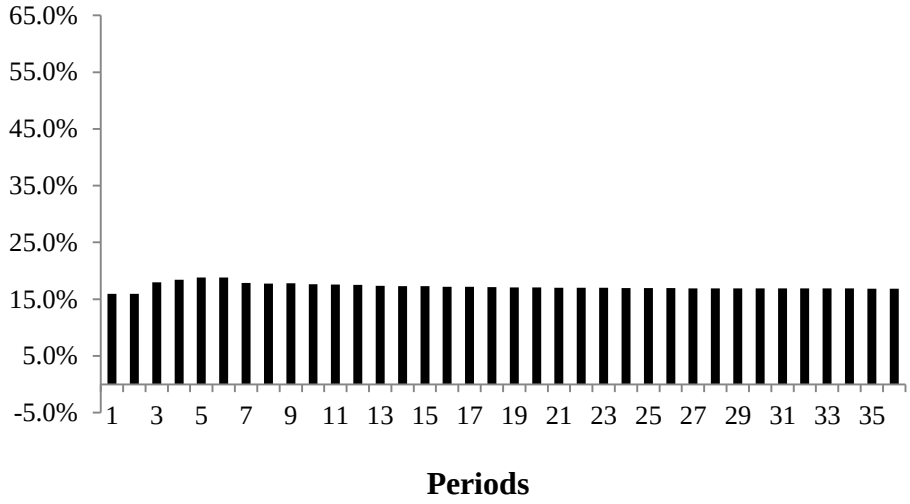
Note. Variance decomposition analysis on the basis of (3) – (12) B–Q SVAR estimations showing the percentage of variance of bad loans to firms explained by loans to firms of all Italian banks.

Figure 6c. *Variance decomposition (loans to households to bad loans to households of all banks)*



Note. Variance decomposition analysis on the basis of (3) – (12) B–Q SVAR estimations showing the percentage of variance of bad loans to households explained by loans to households of all Italian banks.

Figure 6d. *Variance decomposition (total loans to total bad loans of Cooperative Credit Banks)*



Note. Variance decomposition analysis on the basis of (3) – (12) B–Q SVAR estimations showing the percentage of variance of total bad loans explained by total loans of all Italian banks.

Tables

Table 1. *List of variables*

Variables	**Name**	**Source**	**Units**	**# observ.**	**Freq.**
Total Bad loans	SOFF_ITA	Bank of Italy	mln. euros	169	monthly
Total Loans	IMP_ITA	Bank of Italy	mln. euros	169	monthly
Total Bad loans to firms	SOFF_FIR_ITA	Bank of Italy	mln. euros	169	monthly
Total Loans to firms	IMP_FIR_ITA	Bank of Italy	mln. euros	169	monthly
Total Bad loans to households	SOFF_HOU_ITA	Bank of Italy	mln. euros	169	monthly
Total Loans to households	IMP_HOU_ITA	Bank of Italy	mln. euros	169	monthly
Total Bad loans (BCC)	SOFF_BCC_ITA	Bank of Italy	mln. euros	169	monthly
Total Loans (BCC)	IMP_BCC_ITA	Bank of Italy	mln. euros	169	monthly
Industrial Production	IPI_ITA	Istat	(% ch. y/y)	169	monthly
Unemployment rate	UNEMR_ITA	Istat	%	169	monthly
CPI	CPI_ITA	Istat	(% ch. y/y)	169	monthly
Retail sales	RET_SALES_ITA	Istat	(% ch. y/y)	169	monthly
Housing Price Index	HOUS_PRI_ITA	Bloomberg	(% ch. y/y)	169	monthly
Euribor interest rate (3 months)	EURIBOR_3M	ECB	%	169	monthly
IRS 10 years	IRS_10Y	Bloomberg	%	169	monthly
Interest rate slope (3M – 10Y)	SLOPE_3M_10Y	-	%	169	monthly
FTSE MIB Index	FTSE_MIB	Bloomberg	Index	169	monthly

Table 2. *Descriptive statistics*

	Mean	Median	Maximum	Minimum	Standard deviation	Skewness	Kurtosis	# Observ.
Bad Loans	57873.94	51827.04	113078	39582.71	17229.19	1.812214	5.426497	169
Bad Loans to Firms	35535.97	31637.54	75195.9	24931.07	12147.25	1.891203	5.608524	169
Bad Loans to Households	12848.39	11263.59	25851.54	8629.95	4139.452	2.028945	6.016291	169
Bad loans BCC	2966.966	2262.478	7826.142	1637.143	1605.496	1.55077	4.210696	169
Loans	1315124	1207437	1983974	716373.3	415291	0.300645	1.645879	169
Loans to Firms	655258.8	629117	914848	383188.5	173802	0.051176	1.553201	169
Loans to Households	295621.3	287195.3	507196.8	122342.8	116115.7	0.341897	1.978053	169
Loans BCC	79644.53	77818.2	132905.7	28301.84	34547.5	0.109294	1.610684	169
Industrial Production	-0.0091	0.001	0.114	-0.259	0.064794	-1.65365	6.762785	169
Unemployment	0.084831	0.083	0.114	0.0605	0.014767	0.382177	2.355258	169
CPI	0.022988	0.023	0.042	-0.001	0.00755	-0.1324	3.803218	169
Retail Sales	0.00472	0.007	0.1744	-0.068	0.026972	1.310953	13.36258	138
Housing Pricing	0.07087	0.073	0.198	-0.05	0.075945	0.125468	1.631214	169
Euribor 3 Months	0.027709	0.02669	0.05277	0.006431	0.013319	0.092036	1.920596	163
IRS 10 years	0.041897	0.042184	0.0595	0.01678	0.009503	-0.15382	2.550469	162
Interest rate slope	0.014218	0.014633	0.02883	-0.00606	0.00809	-0.3767	2.41511	162
FTSE Mib Index	30233.18	30903	48479	12873.84	8877.925	0.045477	2.042134	169

Table 3. *Unit root analysis*

	Levels			*First differences*		
	ADF	*KPSS*	*PP*	*ADF*	*KPSS*	*PP*
Bad Loans	1.401802	0.297041	1.204577	-10.61439	0.977093	-11.51323
Bad Loans to Firms	1.474598	0.295898	1.192701	-10.50626	1.009808	-11.39100
Bad Loans to Households	1.386049	0.292947	1.248764	-11.11880	0.888709	-11.72823
Bad loans BCC	1.727974	0.365565	5.371583	-0.841602	1.340487	-12.19988
Gross Loans	-1.822335	0.292393	-1.837794	-12.37217	0.173698	-12.37217
Net Loans	-1.583733	0.239620	-1.627998	-12.18950	0.153040	-12.19017
Gross Loans to Firms	-0.635990	0.142604	-0.933627	-13.12600	0.226555	-13.23297
Net Loans to Firms	-2.014944	0.145170	0.123295	-1.546378	0.374338	-12.42516
Gross Loans to Households	-1.817074	0.228654	-1.939892	-11.81626	0.161839	-11.80515
Net Loans to Households	-2.088829	0.202939	-2.226279	-11.89827	0.102464	-11.88655
Gross Loans BCC	-1.043042	0.242339	-1.185160	-5.811215	0.304718	-15.84326
Net Loans BCC	-1.758857	0.296466	-2.054487	-6.114972	0.442484	-16.29628
Industrial Production	-4.130284	0.043998	-3.388272	-	-	-
Unemployment	0.268942	0.359115	1.446915	-3.400715	0.831669	-12.38598
CPI	-2.293292	0.069867	-2.480641	-11.97279	0.063459	-11.95257
Retail Sales	-8.969387	0.080123	-8.957823	-	-	-
Housing Price Index	-1.904995	0.203017	-1.603802	-5.823740	0.120458	-5.823740
Euribor 3 Months	-2.168552	0.110482	-1.964922	-6.457750	0.094856	-6.500350
IRS 10 years	-2.687605	0.107449	-2.998832	-10.44627	0.221301	-10.42250
Interest rate slope	-2.329905	0.110526	-2.434446	-9.572045	0.056039	-9.517479
FTSE Mib Index	-1.735073	0.133367	-1.910261	-12.75286	0.133133	-12.80477
Critical value (1%)	-4.013608	0.216000	-4.013608	-3.469691	0.739000	-3.469691
Critical value (5%)	-3.436795	0.146000	-3.436795	-2.878723	0.463000	-2.878723
Critical value (10%)	-3.142546	0.119000	-3.142546	-2.576010	0.347000	-2.576010

Acronyms. ADF = Augmented Dickey Fuller test statistics; KPSS = Kwiatkoswky – Phillips – Schmidt – Shin test statistics; PP = Phillips – Perron statistic test.
The unit root tests for the levels are with an intercept and a trend. Those for the first difference are with a trend only.

Table 4a. *Dynamic cross-correlations (I)*

	Bad loans (all banks)												
	t	*t+1*	*t+2*	*t+3*	*t+4*	*t+5*	*t+6*	*t+7*	*t+8*	*t+9*	*t+10*	*t+11*	*t+12*
Loans	-0.09	-0.11	-0.05	0.01	-0.06	-0.09	-0.15	-0.07	0.07	0.01	-0.08	-0.07	-0.09
Industrial Production	-0.15	-0.13	-0.16	-0.16	-0.20	-0.18	-0.16	-0.16	-0.16	-0.18	-0.13	-0.13	-0.20
Unemployment rate	0.12	0.02	0.11	0.23	0.03	0.07	0.18	-0.03	0.07	0.23	0.06	0.11	0.17
Consumer Price Index	-0.22	-0.25	-0.21	-0.14	-0.16	-0.14	-0.12	-0.10	-0.06	-0.05	-0.04	-0.01	0.01
Retail sales	-0.15	-0.03	-0.18	-0.18	-0.45	-0.12	-0.09	0.01	0.02	-0.18	-0.03	-0.07	-0.08
House price index	-0.24	-0.24	-0.24	-0.24	-0.23	-0.22	-0.22	-0.21	-0.21	-0.20	-0.20	-0.20	-0.19
Euribor 3M interest rate	-0.40	-0.41	-0.38	-0.36	-0.34	-0.31	-0.29	-0.28	-0.25	-0.22	-0.19	-0.18	-0.15
Irs rate 10Y	-0.30	-0.31	-0.29	-0.29	-0.29	-0.29	-0.25	-0.25	-0.23	-0.22	-0.22	-0.20	-0.18
Interest rate slope	0.31	0.32	0.28	0.25	0.22	0.18	0.18	0.17	0.14	0.10	0.06	0.05	0.04
	Bad loans to firms (all banks)												
	t	*t+1*	*t+2*	*t+3*	*t+4*	*t+5*	*t+6*	*t+7*	*t+8*	*t+9*	*t+10*	*t+11*	*t+12*
Loans	-0.09	-0.28	-0.15	-0.03	0.02	-0.22	-0.35	-0.07	-0.02	-0.10	-0.08	-0.21	-0.16
Industrial Production	-0.17	-0.15	-0.19	-0.18	-0.21	-0.19	-0.17	-0.18	-0.16	-0.18	-0.13	-0.13	-0.19
Unemployment rate	0.11	0.02	0.12	0.23	0.03	0.08	0.17	-0.02	0.09	0.23	0.06	0.11	0.17
Consumer Price Index	-0.22	-0.24	-0.19	-0.12	-0.14	-0.12	-0.09	-0.07	-0.03	-0.02	-0.01	0.02	0.04
Retail sales	-0.15	-0.06	-0.21	-0.18	-0.44	-0.11	-0.09	0.01	0.02	-0.16	-0.03	-0.06	-0.06
House price index	-0.23	-0.23	-0.23	-0.23	-0.22	-0.21	-0.20	-0.20	-0.19	-0.18	-0.18	-0.18	-0.17
Euribor 3M interest rate	-0.41	-0.41	-0.38	-0.36	-0.34	-0.31	-0.29	-0.27	-0.24	-0.21	-0.18	-0.16	-0.14
Irs rate 10Y	-0.31	-0.31	-0.30	-0.29	-0.29	-0.29	-0.26	-0.26	-0.24	-0.22	-0.22	-0.20	-0.18
Interest rate slope	0.31	0.32	0.28	0.25	0.22	0.17	0.16	0.14	0.12	0.08	0.03	0.02	0.01

Note. All variables (with the exception of the industrial production and retail sales indices) are in logarithmic differences and have been standardized.

Table 4b. *Dynamic cross-correlations (II)*

	Bad loans to households (all banks)												
	t	*t+1*	*t+2*	*t+3*	*t+4*	*t+5*	*t+6*	*t+7*	*t+8*	*t+9*	*t+10*	*t+11*	*t+12*
Loans	0.15	-0.01	-0.06	0.01	0.06	0.02	-0.09	0.34	0.01	-0.05	-0.04	-0.10	-0.06
Industrial Production	-0.10	-0.06	-0.09	-0.10	-0.16	-0.13	-0.12	-0.13	-0.16	-0.18	-0.14	-0.14	-0.21
Unemployment rate	0.12	0.03	0.06	0.22	0.01	0.02	0.19	-0.04	0.03	0.22	0.06	0.09	0.16
Consumer Price Index	-0.24	-0.28	-0.24	-0.19	-0.21	-0.19	-0.16	-0.16	-0.12	-0.12	-0.10	-0.07	-0.05
Retail sales	-0.14	-0.02	-0.10	-0.16	-0.38	-0.11	-0.07	-0.02	-0.01	-0.19	-0.04	-0.09	-0.11
House price index	-0.24	-0.24	-0.25	-0.25	-0.24	-0.24	-0.24	-0.24	-0.24	-0.23	-0.23	-0.23	-0.22
Euribor 3M interest rate	-0.37	-0.38	-0.36	-0.33	-0.32	-0.30	-0.29	-0.28	-0.26	-0.24	-0.21	-0.20	-0.18
Irs rate 10Y	-0.28	-0.28	-0.27	-0.26	-0.27	-0.26	-0.22	-0.22	-0.21	-0.20	-0.21	-0.19	-0.17
Interest rate slope	0.28	0.30	0.27	0.24	0.21	0.18	0.21	0.20	0.18	0.14	0.10	0.11	0.09
	Bad loans to firms (Cooperative Credit Banks)												
	t	*t+1*	*t+2*	*t+3*	*t+4*	*t+5*	*t+6*	*t+7*	*t+8*	*t+9*	*t+10*	*t+11*	*t+12*
Loans	0.10	-0.11	-0.33	0.10	-0.18	-0.10	-0.04	-0.12	-0.20	0.01	-0.08	-0.05	0.03
Industrial Production	-0.20	-0.18	-0.21	-0.16	-0.18	-0.16	-0.15	-0.12	-0.11	-0.14	-0.12	-0.11	-0.14
Unemployment rate	0.07	0.16	0.20	0.07	0.23	0.19	0.10	0.12	0.16	0.18	0.08	0.15	0.15
Consumer Price Index	-0.07	-0.06	-0.08	-0.08	-0.09	-0.08	-0.02	-0.01	0.01	-0.01	-0.01	0.02	0.02
Retail sales	-0.23	-0.22	-0.18	-0.19	-0.26	-0.20	-0.17	-0.22	-0.12	-0.22	-0.10	-0.15	-0.10
House price index	-0.32	-0.31	-0.31	-0.31	-0.31	-0.29	-0.31	-0.30	-0.30	-0.29	-0.29	-0.29	-0.29
Euribor 3M interest rate	-0.29	-0.28	-0.26	-0.24	-0.22	-0.20	-0.18	-0.15	-0.14	-0.13	-0.12	-0.13	-0.12
Irs rate 10Y	-0.34	-0.35	-0.33	-0.33	-0.32	-0.28	-0.26	-0.26	-0.22	-0.21	-0.22	-0.20	-0.19
Interest rate slope	0.10	0.06	0.05	0.02	0.00	0.01	-0.01	-0.05	-0.03	-0.02	-0.06	-0.02	-0.02

Note. All variables (with the exception of the industrial production and retail sales indices) are in logarithmic differences and have been standardized.

Table 5a. *Regression results*

Dependent Variable: Bad loans

Regressors	*Equation (1)*			*Equation (2)*	
	Coeff.		*Adj. R^2*	*Coeff.*	
Intercept	-		-	0.010	***
Bad loans (t-1)	-		-	0.021	
Bad loans (t-7)	-		-	0.137	***
Industrial production (-7)	-0.203	***	0.634	-	
Unemployment (-9)	0.197	***	0.630	0.084	*
Consumer price index (-1)	-0.202	***	0.625	-	
Retail sales (-2)	-0.141	***	0.682	-	
House pricing index (-3)	-0.145	***	0.607	-	
Euribor 3M (-1)	-0.379	***	0.696	-0.810	**
Euribor 3M (-2)	-0.364	***	0.685	0.475	*
IRS 10Y (-1)	-0.265	***	0.651	-	
Interest rate term structure slope (-1)	0.223	***	0.637	-	
FTSE Mib (-12)	-0.145	***	0.618	-	
Dummy 2001M05	-		-	-4.949	***
Dummy 2005M12	-		-	-6.356	***
Dummy 2011M01	-		-	-4.568	***
Adjusted R^2	-		-	0.702	
DW	-		-	2.047	
LM test - F(12, 133)	-		-	1.288	
# observations	-		-	159	

Note. The estimated regressions are equations (1) and (2). The dependent variable is total bad loans of all Italian banks. All variables (with the exception of industrial production index and retail sales index are in logarithmic differences) and have been standardized. *: significant at the 10% level, **: significant at the 5% level, ***: significant at the 1% level.

Table 5b. *Regression results*

Dependent Variable: Bad loans to firms

Regressors	*Equation (1)*			*Equation (2)*	
	Coeff.		*Adj. R^2*	*Coeff.*	
Intercept	-		-	1.291	***
Bad Loans to Firms (t-1)	-		-	-0.092	*
Bad Loans to Firms (t-2)	-		-	-0.025	
Industrial production (-7)	-0.207	***	0.601	-	
Unemployment (-9)	0.199	***	0.597	0.099	**
Consumer price index (-1)	-0.183	***	0.579	-0.174	***
Retail sales (-2)	-0.170	***	0.662	-0.082	*
House pricing index (-1)	-0.134	**	0.565	-	
Euribor 3M (-1)	-0.382	***	0.663	-0.221	***
Euribor 3M (-2)	-0.363	***	0.650	-	
IRS 10Y (-1)	-0.262	***	0.616	-	
Interest rate term structure slope (-1)	0.225	***	0.603	-	
FTSE Mib (-12)	-0.120	**	0.562	-0.084	*
Dummy 2001M5	-		-	-5.222	***
Dummy 2005M12	-		-	-6.019	***
Dummy 2011M01	-		-	-4.121	***
Adjusted R^2	-		-	0.754	
DW	-		-	2.172	
LM test – F(12, 113)	-		-	0.136	
# observations	-		-	136	

Note. The estimated regressions are equations (1) and (2). The dependent variable is bad loans to firms of all Italian banks. All variables (with the exception of industrial production index and retail sales index are in logarithmic differences) and have been standardized. *: significant at the 10% level, **: significant at the 5% level, ***: significant at the 1% level.

Table 5c. *Regression results*

Dependent Variable: Bad loans to to Households

Regressors	*Equation (1)*			*Equation (2)*	
	Coeff.		*Adj. R^2*	*Coeff.*	
Intercept	-		-	0.975	***
Bad Loans to Hosueholds (t-1)	-		-	-2.484	
Bad Loans to Hosueholds (t-2)	-		-	0.595	
Industrial production (-9)	-0.174	***	0.801	-	
Unemployment (-9)	0.154	***	0.794	0.066	*
Consumer price index (-1)	-0.167	***	0.791	-0.120	***
Retail sales (-2)	-0.132	*	0.721	-	
House pricing index (-8)	-0.167	***	0.798	-0.130	***
Euribor 3M (-1)	-0.219	***	0.803	-0.888	***
Euribor 3M (-2)	-0.198	***	0.796	0.766	***
IRS 10Y (-1)	-0.163	***	0.792	-	
Interest rate term structure slope (-1)	0.111	**	0.781	-	
FTSE Mib (-12)	-0.098	**	0.777	-	
Dummy 1999M12	-		-	-2.818	***
Dummy 2000M12	-		-	-2.171	***
Dummy 2001M05	-		-	-4.620	***
Dummy 2005M12	-		-	-5.120	***
Dummy 2008M04	-		-	-1.614	***
Dummy 2008M12	-		-	-4.196	***
Dummy 2011M01	-		-	-5.786	***
Adjusted R^2	-		-	0.849	
DW	-		-	2.164	
LM test - F(12, 132)	-		-	0.496	
# observations	-		-	159	

Note. The estimated regressions are equations (1) and (2). The dependent variable is bad loans to households of all Italian banks. All variables (with the exception of industrial production index and retail sales index are in logarithmic differences) and have been standardized. *: significant at the 10% level, **: significant at the 5% level, ***: significant at the 1% level.

Table 5d. *Regression results*

Dependent Variable: Bad loans Cooperative Credit Banks (BCC)

Regressors	*Equation (1)*			*Equation (2)*	
	Coeff.		*Adj. R^2*	*Coeff.*	
Intercept	-		-	0.584	***
Bad loans CCB (t-1)	-		-	-0.003	
Bad loans CCB (t-2)	-		-	0.014	
Industrial production (-2)	-0.119	***	0.747	-0.096	**
Unemployment (-2)	0.134	***	0.742	0.076	*
Consumer price index (-1)	0.011		0.719	-0.165	***
Retail sales (-2)	-0.101		0.727	-	
House pricing index (-4)	-0.185	***	0.754	-	
Euribor 3M (-1)	-0.203	*	0.729	-	
Euribor 3M (-2)	-0.175		0.712	-	
IRS 10Y (-1)	-0.151		0.708	-	
Interest rate term structure slope (-1)	0.126		0.711	-	
FTSE Mib (-12)	-0.142	***	0.748	-0.122	***
Dummy 1998M11	-		-	-2.583	***
Dummy 1998M12	-		-	-3.037	***
Dummy 2002M07	-		-	-8.749	***
Dummy 2009M12	-		-	-2.278	***
Dummy 2010M07	-		-	2.057	***
-	-		-	-	
-	-		-	-	
Adjusted R^2	-		-	0.785	
DW	-		-	1.881	
LM test – F(12, 139)	-		-	2.208	
# observations	-		-	136	

Note. The estimated egressions are equations (1) and (2). The dependent variable is total bad loans of Italian Cooperative Credit Banks. All variables (with the exception of industrial production index and retail sales index are in logarithmic differences) and have been standardized. *: significant at the 10% level, **: significant at the 5% level, ***: significant at the 1% level.

Table 6. *Cointegration tests*

Cointegration vectors	Rank		Eigenvalue	Trace test		Maximum eigenvalue test	
	p-r	r		Statistic	CV at 95%	Statistic	vc al 95%
TBL / L ALL	2	0	0.064884	11.58854	15.49471	10.86766	14.26460
	1	1	0.004440	0.720881	3.841466	0.720881	3.841466
BLF / LF ALL	2	0	0.063991	10.70131	15.49471	10.18398	14.26460
	1	1	0.003354	0.517333	3.841466	0.517333	3.841466
BLH / LH ALL	2	0	0.042332	9.314032	15.49471	7.007119	14.26460
	1	1	0.014139	2.306913	3.841466	2.306913	3.841466
TBL / L CCB	2	0	0.053790	10.27505	15.49471	8.957105	14.26460
	1	1	0.008102	1.317945	3.841466	1.317945	3.841466

Acronyms. TBL / L ALL = Cointegration is tested for Total Bad Loans and total Loans of all Italian banks, BLF / LF ALL = Cointegration is tested for Bad Loans to Firms and total Loans to Firms of all Italian banks, BLH / LH ALL = Cointegration is tested for Bad Loans to Households and total Loans to Households of all Italian banks, TBL / L CCB = Cointegration is tested for Total Bad Loans and total Loans of Italian Cooperative Credit Banks.
Note. P is the VAR lag order, *r* is the cointegration rank.

Table 7. *Diagnostic Tests for Bi-variate VAR*

	TBL ALL		BLF		BLH		TLB CCB	
		p-value		*p-value*		*p-value*		*p-value*
Autocorrelation LM $AR_{(t-6)}$	4.0829	[0.3949]	8.1952	[0.0847]	3.8370	[0.4285]	8.36552	[0.0791]
Autocorrelation Portmanteau	7.3379	[0.1191]	10.3044	[0.0629]	9.2134	[0.0712]	5.79369	[0.2151]
Normality (JB)	18391.1	[0.0000]	1305.3	[0.0000]	36618.5	[0.0000]	31756.5	[0.0000]
Heteroschedasticity	196.02	[0.9998]	239.563	[0.2901]	208.947	[0.9977]	257.252	[0.7015]

Acronyms. TBL ALL = Total Bad Loans of all Italian banks, BLF = Bad Loans to Firms of all Italian banks, BLF = Bad Loans to Households of all Italian banks, TBL CCB = Total Bad Loans of Italian Cooperative Credit Banks.
Note. Testsof uncorrect specification are referred to B-Q SVAR estimations under (3) – (12). *P-value* under brackets.

Table 8. *Pairwise Granger causality tests*

	Caused by	Chi-sq	p-value	lags	# obs.
Total Loans – all banks	Bad loans	28.1127	0.0001	6	162
Loans to firms	Bad loans firms	35.4145	0.0000	6	162
Loans to households	Bad loans hous.	3.3777	0.7602	6	162
Total loans - BCCs	Bad loans BCC	17.3104	0.0082	6	162

Note. Block exogeneity Wald Test.